Customer Instruction Manual

POLYCOLD CLOSED LOOP GAS CHILLER

MODEL 2XCL-3-SE
440VAC Part # 700188-06

MODEL 2XCL-3-SE 2
440VAC Part # 700188-07

MODEL 2XCL-3-SE 2, 480V
480VAC Part # 700188-09

Serial # _____

TABLE OF CONTENTS

1.0 INTRODUCTION 4
1.1 FOREWORD 4
1.2 SERVICE 5
1.3 BEFORE YOU START 5
1.4 HAZARD ALERTS INFORMATION 6
1.5 USER PRECAUTIONS 14
1.6 SAFETY INFORMATION 16
1.7 SAFETY TRAINING GUIDELINES 18
1.8 LOCK-OUT, TAG-OUT PROCEDURE 19
2.0 INSTALLATION 20
2.1 SYSTEM DIAGRAMS 20
Figure 1: Electrical Distribution Diagram 21
Figure 2: System Block Diagram 22
Figure 3: Dimensions, Front (version -06) 23
2.2 ABOUT THE 2XCL 27
.1 3. Unit Features: 28
2.3 INSPECT AND INSTALL THE 2XCL 30
2.4 CONNECT THE COOLING WATER 39
2.5 INSTALL THE EXTERNAL GAS CIRCUIT AND GAS FILL LINE 40
2.6 EMERGENCY OFF CIRCUIT 42
3.0 OPERATION 42
3.1 INITIAL START-UP 42
3.2 BAKE-OUT AND POST BAKE COOLING 43
3.3 RESETTING SAFETY INTERLOCKS AFTER FAULT 43
4.0 INSPECTION & MAINTENANCE 44
5.0 DISCONNECTION, STORAGE, AND RESHIPMENT 46
6.0 TROUBLESHOOTING 48
6.1 GENERAL TROUBLESHOOTING MATRIX 49
6.2 REFRIGERATION COMPRESSOR FAULT MODES 51
Indicator Lamps Based Troubleshooting Matrix (Normal Modes) 51
Indicator Lamps Based Troubleshooting Matrix (Fault Modes) 52
6.3 GAS COMPRESSOR UNIT (HC-10) FAULT MODES 56
6.4 AUTOFILL TROUBLESHOOTING BASICS 62
6.5 AUTOFILL TROUBLESHOOTING MATRIX 63
6.6 AUTOFILL STATUS TABLES 64
6.7 AUTOFILL RELAYS AND SOLENOID VALVE 65
6.8 ADJUSTING AUTOFILL CONTROL SETTINGS 66
7.0 APPENDIX 67
7.1 BRAZING SPECIFICATION 67
7.2 THERMOCOUPLE ATTACHMENT SPECIFICATION 68
7.3 SPECIFICATIONS 69
7.4 DESIGN DATA 69
7.5 INSTRUCTIONS FOR INSTALLATION OF SEISMIC ANCHOR/JACK SCREWS 70
8.0 GLOSSARY 75
9.0 PROCESS & INSTRUMENTATION AND ELECTRICAL SCHEMATICS 77

Polycold® Systems Cooling Products, CryoTiger®,AquaTrap®, Polycold Compact Cooler, Repair Services and Certified Refurbished Products

Polycold® Systems cryogenic cooling products, including water vapor cryopumps (PFC, PCT, FLC, FI), chillers (PGC, PGCL), cryocoolers (P), CryoTiger, AquaTrap, Polycold Compact Cooler (PCC) and accessories, Certified Refurbished products (the "Products") and Repair Service (i.e.- repairs other than warranty repairs) are warranted to be free from defects in materials and/or workmanship under normal service for the time period as set forth in Table A below from date of shipment from Brooks Automation, Inc. ("Brooks"). The warranty for Repair Service and Products is limited to the component parts replaced or repair performed by Brooks at Brooks' facility. Customer is responsible for all charges and expenses for Brooks Services provided at Customer's location by Brooks technicians as set forth in a quotation. Certified Refurbished Products and warranty exchange Products are remanufactured to like-new condition and contain used parts and materials.

Table A

Product	New Product Warranty	Repair Service Warranty	Certified Refurbished Cryogenic Cooling Products Warranty
Cryotiger® Products and Systems AquaTrap® Products and Systems Polycold® Compact Cooler (PCC)	15 Months	12 Months	N/A
Cryogenic cooling products, including: Water vapor cryopumps (PFC, PCT, FLC, FI), chillers (PGC, PGCL), cryocoolers (P), and accessories	24 Months	12 Months	12 months

BROOKS MAKES NO OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO PRODUCTS OR SERVICES. UNLESS EXPRESSLY IDENTIFIED AS A WARRANTY, SPECIFICATIONS IN ANY PRODUCT DATASHEET CONSTITUTE PERFORMANCE GOALS ONLY, AND NOT WARRANTIES. BROOKS MAKES NO WARRANTY RESPECTING THE MERCHANTABILITY OF PRODUCTS OR THEIR SUITABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR RESPECTING INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. BROOKS DISCLAIMS ANY WARRANTY WITH RESPECT TO PRODUCTS MODIFIED WITHOUT BROOKS' WRITTEN CONSENT, REPAIRS MADE OUTSIDE OF OUR FACTORY, PRODUCTS RENDERED DEFECTIVE BY CUSTOMER MISUSE, NEGLIGENCE, CORROSIVE ATMOSPHERES, ATTACK BY FREE CHEMICALS WITHIN THE SYSTEM, ACCIDENT, DAMAGE BY CUSTOMER OR CUSTOMER'S AGENT, OPERATION CONTRARY TO OUR RECOMMENDATION, IF THE SERIAL NUMBER HAS BEEN ALTERED, DEFACED OR REMOVED, THE USE OF SERVICE REPLACEMENT REFRIGERANTS FROM ANY THIRD PARTY NOT LICENSED BY BROOKS, OR THE PRODUCT IS OTHERWISE COMPROMISED BY USE OF UNAUTHORIZED PARTS OR SERVICE, ALL AS DETERMINED BY BROOKS IN ITS SOLE DISCRETION.

IN NO EVENT WILL CUSTOMER BE ENTITLED TO, NOR WILL BROOKS BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE OR CONSEQUENTIAL DAMAGES OF ANY NATURE, INCLUDING WITHOUT LIMITATION NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, ARISING AT ANY TIME, FROM ANY CAUSE WHATSOEVER, INCLUDING, WITHOUT LIMITATION, DOWN-TIME COSTS, DATA LOSS, DAMAGE TO ASSOCIATED EQUIPMENT, REMOVAL AND/OR REINSTALLATION COSTS, REPROCUREMENT COSTS, OR LOST PROFITS, EVEN IF BROOKS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND EVEN IF THE LIMITED REMEDIES OF REPAIR OR REPLACEMENT FAIL OF THEIR ESSENTIAL PURPOSE. THIS WAIVER OF LIABILITY DOES NOT APPLY TO EITHER BROOKS' LIABILITY UNDER A STATUTE, ACT OR LAW PERTAINING TO BODILY INJURY, OR TO ANY LIABILITY INCURING OUT OF DAMAGE TO THE BODY, HEALTH OR LIFE OF A PERSON.

The exclusive remedies for breach of warranty will be either repair or replacement of the nonconforming parts or Products during the warranty period at the sole discretion of Brooks, shipped ExWorks (Incoterms 2000) Brooks factory. Customer's recovery from Brooks for any claim shall not exceed the amount paid by customer to Brooks for the Product or Service giving rise to such claim, irrespective of the nature of the claim, whether in contract, tort, warranty, or otherwise. Customer must inspect the Products within a reasonable time upon receipt, and must notify Brooks within 30 days of discovering a defect. Every claim on account of defective material or workmanship shall be deemed waived unless made in writing within the warranty period specified above. Brooks does not assume, or authorize any other person to assume, any other obligations or liabilities in connection with the sale of the Products.

All Polycold Products are also subject to the Brooks Automation, Inc. General Terms and Conditions, Polycold® Products, an excerpt of which is set forth above.

Polycold® is a registered trademark of Brooks Automation, Inc.

3800 Lakeville Hwy • Petaluma, California 94954 U.S.A. • 707.769.7000 • Toll Free: 888.4.Polycold • Fax 707.769.1380
E-mail petaluma.sales@brooks.com • www.brooks.com

1.0 INTRODUCTION

1.1 FOREWORD

Polycold's *Cool Solutions*® low temperature gas chillers are used to allow low temperature vacuum processing of semiconductor device wafers as well as other applications. Vacuum processing systems use recirculating fluids to keep the wafer at controlled temperature. The wafer sits on a pedestal or table in vacuum and is processed, typically in a vacuum with specific gases and metallic vapors to create a uniform coating on the wafer.

Gas circulating in the secondary loop of the 2XCL closed loop gas chiller is cooled in the gas chiller. The temperature of the gas leaving the gas chiller can reach temperatures of –100°C. The chilled gas is recirculated by a secondary gas compressor. The customer-installed lines connecting the gas chiller and the pedestal are vacuum jacketed to minimize the heat leaks from the ambient to the chilled gas.

The system consists of a refrigeration system, which chills the secondary gas, a secondary gas recirculating compressor, interconnecting gas lines, and the table in the vacuum system. The refrigeration system uses a propriety and patented blend of refrigerants. The secondary loop compressor uses an inert gas whose dew point is below –80°C. The refrigeration system as well as the secondary gas loop requires cooling water. There is no co-mixing of the refrigerant and the secondary gas. The equipment is designed for continuous operation. Electricity, cooling water, and pressurized dry nitrogen are the only required utilities.

Pressures are stated as gauge, not absolute. Psig is pounds per square-inch-gauge and kPa is Kilopascals-gauge.

$$kPa = 6.895 \times Psig$$
$$bar = Psig \div 14.5$$

This technical manual contains Safety, Service, Introduction, Specifications, Installation, Operation, Maintenance, and Parts information for all the equipment in the system.

Notes:

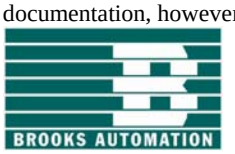
⚠ATTENTION!

REVIEW THE INSTRUCTION MANUAL BEFORE OPERATING THIS EQUIPMENT!

Upon arrival of the equipment and prior to starting its installation or operation confirm that the balance pressure (BP) shown on the suction pressure gauge is between 165 – 190 psi. Refer to section 2.3, Item 1.

1.2 SERVICE

Information provided within this document is subject to change without notice, and although believed to be accurate, Brooks Automation assumes no responsibility for any errors, omissions, or inaccuracies.
AcuLigner, AcuLine, AcuTran, AcuTrav, AeroLoader IV, AeroTrak, ARV 2000, AquaTran, Atmospheric Express, BALI 400 Indexer, BiSymmetrik, ExpressLock, FabExpress, FixLoad, FrogLeg, Gemini, Gemini Express, Gemini Express Tandem, Guardian Bare Reticle Stocker, Hercules, Hercules Express, InCooler, InLigner, InLine Express, Leapfrog, Linear eXchange, MagnaTran 7, MagnaTran 70, MagnaTran 8, MagnaTran X, Marathon, Marathon Express, Marathon Express Tandem, MicroTool, MultiTran, OneFab AMHS, OpenMTS, PASIV, PF-100, PowerPak, Reliance ATR, Reliance DFR, Reliance WCR, SENTRY, TCM, Time Optimal Trajectory, TopCooler, TurboStocker, TurboStocker XT, Ultrasort, VacuTran, VCD, VCE, VPE, WAVE, WAVE II, Zaris, Z-Bot, Aquatrap, Conductron, Convectron, Cool Solutions, Cryodyne, Cryogem, Cryogenerator, CryoTiger, Cryo-Torr, CTI-Cryogenics, FastRegen™, GOLDLink, Granville-Phillips, GUTS, Helix, Micro-Ion, Mini-Convectron, Mini-Ion™, On-Board, Polycold, RetroEase, RetroFast, Stabil-Ion, ThinLine™, True-BlueSM, TurboPlus, and Vacuum AssuranceSM are trademarks of Brooks Automation Hardware.
All other trademarks are properties of their respective owners.
© Brooks Automation 2006, All Rights Reserved. The information included in this manual is Brooks Proprietary Information and is provided for the use of Brooks customers only and cannot be used for distribution, reproduction, or sale without the expressed written permission of Brooks Automation. This information may be incorporated into the user's documentation, however any changes made by the user to this information is the responsibility of the user.



Brooks Automation
15 Elizabeth Drive
Chelmsford, MA 01824
Phone +1 (978) 262-2400
Fax +1 (978) 262-2500
For emergencies, contact Technical Support +1 (978) 262-2900
www.brooks.com

This manual is available in the following languages: English.
This technology is subject to United States export Administration Regulations and authorized to the destination only;
diversion contrary to U.S. law is prohibited.
Printed in the U.S.A.
© 2006 by Brooks Polycold Systems Inc.
All rights reserved.
Printed in the United States of America.
Trademark Recognition:Armaflex® is a registered trademark of Armstrong World Industries, Inc.
CPI UltraSeal™ is a trademark of Parker Hannifin Corporation.
Phillips® is a registered trademark of Phillips Screw Company.
Polycold® is a registered trademark of Brooks Technology Corporation.
VCR® is a registered trademark of Cajon Company.
is a registered trademark of Brooks Technology Corporation.

1.3 BEFORE YOU START

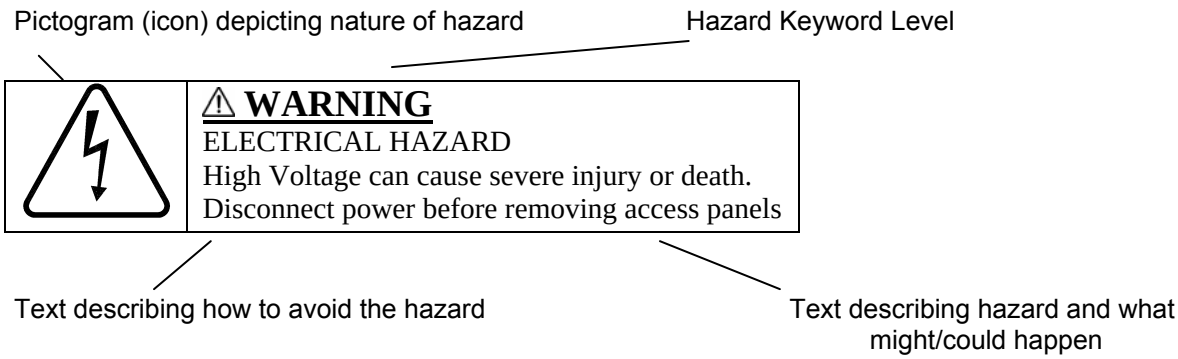
Please have the following information available to help us assist you:

Polycold Model: _____
Polycold Serial No: _____
Date Manufactured: _____

The above information is on the nameplate of your 2XCL. You may wish to enter this information now (before the 2XCL is installed).

1.4 HAZARD ALERTS INFORMATION

VISUAL HAZARD ALERTS USED IN THIS MANUAL AND AS LABELS ON THE EQUIPMENT SHOULD BE REVIEWED AND UNDERSTOOD BY PERSONNEL PRIOR TO USE OF THE SYSTEM. Hazard warnings are provided in this manual before each step that may involve hazards to personnel. See the following hazard alert icons and text for information on icons, which identify potentially hazardous situations/consequences of not avoiding the hazard. Hazard alerts used in the manual and on the equipment follow ANSI Z535 and use the signal words DANGER, WARNING or CAUTION.
The signal words have the following meanings:


Pictogram (icon) depicting nature of hazard
Hazard Keyword Level
⚠ WARNING
ELECTRICAL HAZARD
High Voltage can cause severe injury or death.
Disconnect power before removing access panels
Text describing how to avoid the hazard
Text describing hazard and what might/could happen

HAZARD KEYWORD LEVELS

DANGER	An imminently hazardous situation that, if not avoided, will result in serious injury or death.
WARNING	A potentially hazardous situation that, if not avoided, could result in severe injury or death.
CAUTION	A potentially hazardous situation that, if not avoided, could result in moderate or minor injury or property or equipment damage.

Hazard Warning Labels Identified by Number

1. CAUTION

2. WARNING

WARNING
Hazardous Voltage Enclosed
Voltage or current hazard sufficient to cause shock, burn, or death.
Disconnect and lockout power before servicing.
©2002 HCS, LLC www.safetylabel.com 05103 Reorder No. EH01S298

3. CAUTION

CAUTION
Hot Surface
Do not touch. Can cause skin burns upon contact.
Disconnect and lockout power and allow surface to cool before servicing.
©2004 HCS, LLC www.safetylabel.com 05062 Reorder No. TH01S298

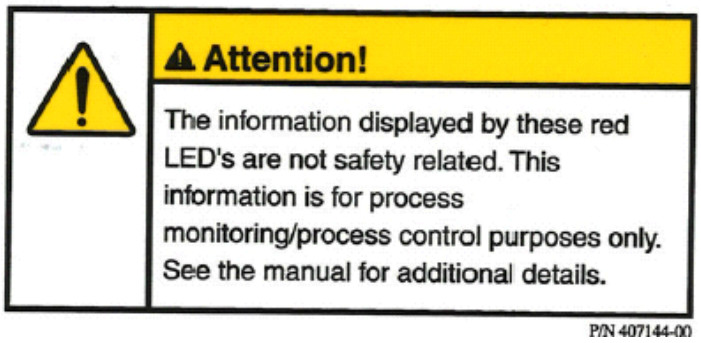
4. ATTENTION

ATTENTION
THIS COMPRESSOR IS CHARGED WITH AN OIL SELECTED SPECIFICALLY FOR THIS EQUIPMENT. REFILL ONLY WITH POLYCOLD PART NUMBER: 081009-00
407119-00

5. CAUTION

CAUTION
Heavy Object
Can cause muscle strain or back injury.
Use lifting aids and proper lifting techniques when removing or replacing.
kg
©2002 HCS, LLC 800-748-0241 www.safetylabel.com 84139 Reorder No. HO02S299

6. ATTENTION


Attention!
The information displayed by these red LED's are not safety related. This information is for process monitoring/process control purposes only. See the manual for additional details.
P/N 407144-00

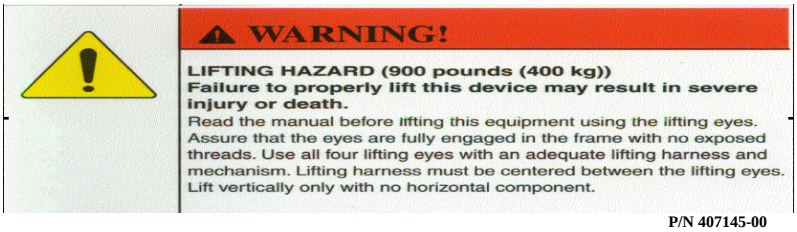
7. WARNING

WARNING!
This valve is to remain sealed open. If this valve is closed when servicing the unit, the unit must be attended until the valve is reopened and resealed.
ACHTUNG!
Dieses Ventil muß im offenen Zustand versiegelt bleiben. Sollte das Ventil während der Wartung des Gerätes geschlossen werden, muß das Gerät überwacht werden, bis das Ventil erneut geöffnet und versiegelt wurde.
P/N 073017-01 REV. 02

8. CAUTION

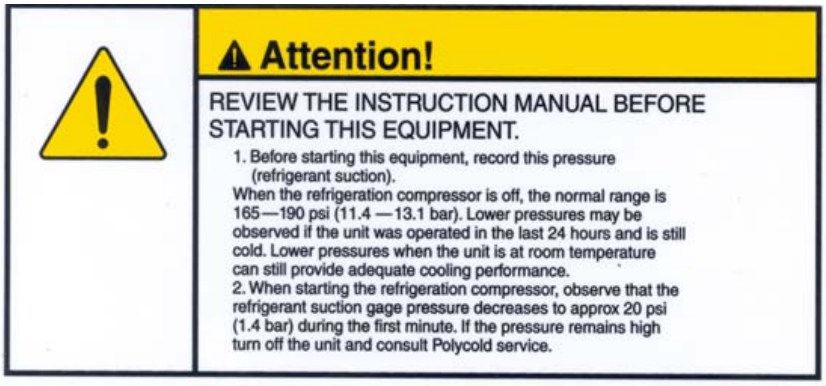
9. SEISMIC ANCHOR P0INT

10.


WARNING!
LIFTING HAZARD (900 pounds (400 kg))
Failure to properly lift this device may result in severe injury or death.
Read the manual before lifting this equipment using the lifting eyes. Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component.

P/N 407145-00

11.


Attention!
REVIEW THE INSTRUCTION MANUAL BEFORE STARTING THIS EQUIPMENT.
1. Before starting this equipment, record this pressure (refrigerant suction).
When the refrigeration compressor is off, the normal range is 165—190 psi (11.4 —13.1 bar). Lower pressures may be observed if the unit was operated in the last 24 hours and is still cold. Lower pressures when the unit is at room temperature can still provide adequate cooling performance.
2. When starting the refrigeration compressor, observe that the refrigerant suction gage pressure decreases to approx 20 psi (1.4 bar) during the first minute. If the pressure remains high turn off the unit and consult Polycold service.

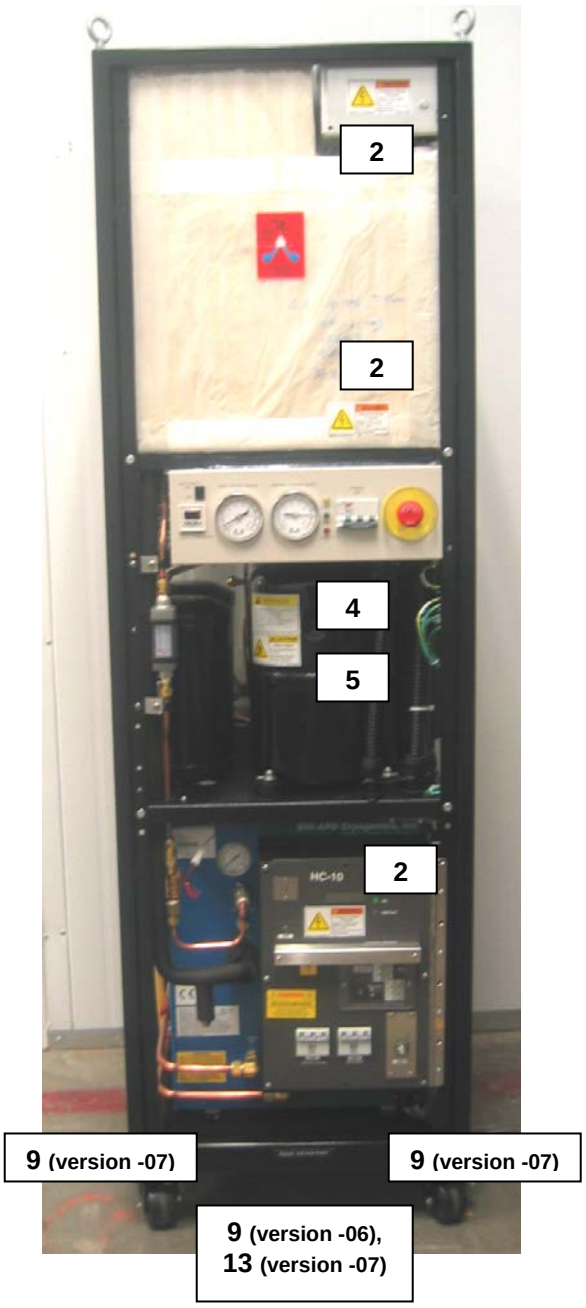
P/N 407149-00

12.

WARNING
TIPPING HAZARD.
HIGH CENTER OF GRAVITY.
LESS THAN 10° MAX TILT ANGLE.
Over tipping (leaning) this device may cause it to fall over resulting in severe injury or death.
Read manual before moving this equipment using the casters.
Move the equipment on level floors only.
Move it slowly and avoid rapid acceleration and deceleration.
Apply force to move the system below the equipment center of gravity.
Do NOT place yourself between the moving equipment and fixed obstructions.
Once equipment is installed, securely fasten frame to floor.
407185-00 REV 00

13.

WARNING
TIPPING HAZARD. HIGH CENTER OF GRAVITY.
LESS THAN 10° MAX TILT ANGLE.
DO NOT LIFT CASTER WHEEL OFF THE FLOOR
This screw and pad are a Seismic Anchor Point. They can be used to secure the unit to the floor using a customer supplied bracket. The caster must bear weight when the foot pad is lowered.
When lowering the foot pad to the floor, do not extend the screw to the point where the caster is lifted off the floor.
407195-00 REV 00

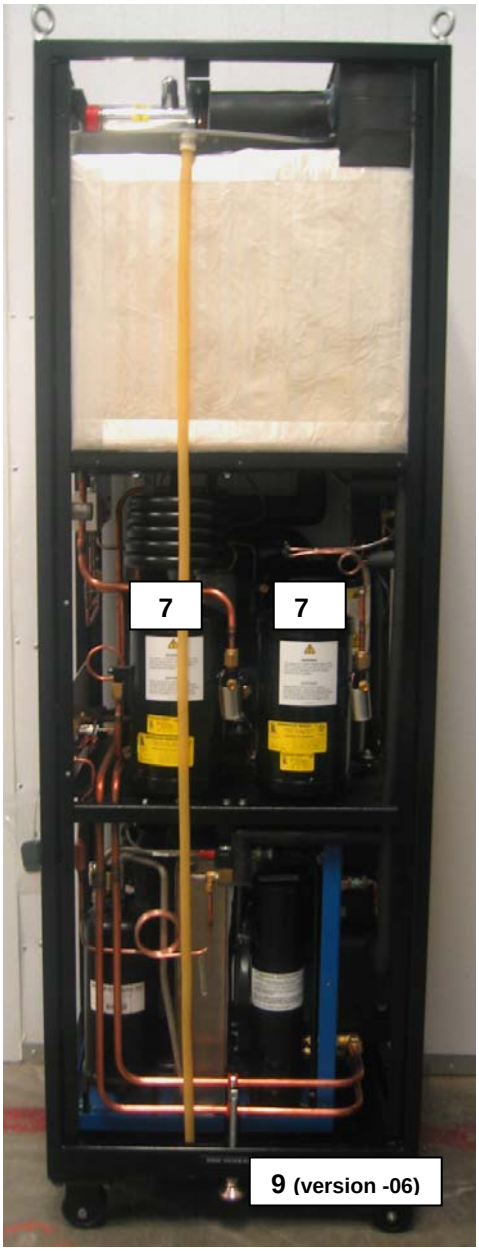


Front View

Right Side View

Interior Label Placement

Rear View



Left Side View

Interior Label Placement, Continued

Exterior, Left Front Oblique

Exterior, Right Rear Oblique

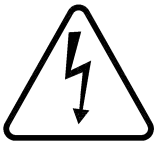
Top View

Exterior Label Placement

1.5 USER PRECAUTIONS

⚠ CAUTION!
REVIEW THE INSTRUCTION MANUAL BEFORE PERFORMING ANY PROCEDURE OTHER THAN THE ROUTINE OPERATION OF THE 2XCL.
Performance of procedures other than those specified herein may result in hazardous exposures to electrical, ultra-low temperature, or moving parts hazards. Additional precautions are located in the appropriate section of this manual.

⚠ CAUTION!
THE 2XCL CONTAINS PRESSURIZED GAS. DO NOT OPEN THE REFRIGERANT CIRCUIT TO THE ATMOSPHERE. All refrigeration work must be performed by qualified, Type 2, High Pressure refrigeration technicians. Do not loosen any valve packing or fittings unless you are specifically following the instructions in the recharge procedure. Discharge of refrigerant may cause personal injury due to high pressures or ultra-low temperatures. In addition, if refrigerant is lost, the 2XCL may need to be re-charged before it can be used.



⚠ WARNING!
HAZARDOUS VOLTAGE EXISTS AT ALL TIMES AFTER THE POWER IS CONNECTED. Only qualified electricians should perform electrical work. Power should be removed at the point of electrical connection, and locked-out following standard lock-out tag-out procedures. A lock-out device may be placed on the supply power circuit breaker (provided by others) or on the supplied electrical power plug.

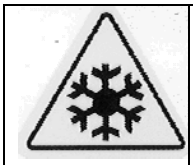
⚠ DANGER! DO NOT REACH INSIDE THE 2XCL WHEN IT IS OPERATING.
The unit contains hazardous voltages and extreme temperatures.

⚠ DANGER! DO NOT TOUCH AN UNINSULATED GAS LINE OR THE EXITING GAS STREAM WHEN THE 2XCL IS OPERATING. The system circulates gas at ultra-low temperatures, which on contact with skin presents the risk of frostbite.

⚠ WARNING!
LIFTING HAZARD (900 pounds (400 kg))
Failure to properly lift this device may result in severe injury or death.
Read the manual before lifting this equipment using the lifting eyes. Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component.

⚠WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. The equipment should be removed from its shipping pallet by using the top installed lifting eyes.

⚠ WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. Read the manual before moving this equipment using the casters. Move the equipment on level floors only. Move it slowly and avoid rapid acceleration and deceleration. Apply force to move the system below the equipment center of gravity. Do not place yourself between the moving equipment and fixed obstructions.



⚠ CAUTION! THIS SYSTEM PRODUCES AND CIRCULATES COLD GAS AT TEMPERATURES AS LOW AS - 110º C. Assure that integrating systems and components are suitable for rapid exposure to these low temperatures.

⚠WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Maintain weight on casters at all times.

1.6 SAFETY INFORMATION

Safety Hazards and Safeguards

NOTE: The user is advised to retain current copies of material safety data sheets (MSDS) for refrigerants and cleaning agents used in the operation and maintenance of this equipment. One copy of the MSDS for the system refrigerant has been attached to this user's manual.

Safety Devices incorporated in the 2XCL and their function is described below:

REFRIGERATION COMPRESSOR UNIT		
Descriptor	Name	Function
PS1	High Pressure Switch	A high-pressure switch is incorporated in the discharge side of the compressor. The switch opens contacts if the refrigerant pressure exceeds normal operating pressure, interrupting power to the compressor and turning it off. This switch requires manual reset. The user should not adjust it.
FP1	Fusible Plug (located on expansion tank)	A fusible plug is installed in the discharge plumbing of the compressor and serves as the controlled release point for refrigerant should a fire occur in the area of the 2XCL. The fusible plug provides a means to reduce high pressures caused by excessive ambient temperatures in a manner that does not result in an explosion.
TS1	High Temperature Switch	A high temperature switch is coupled to the condenser refrigerant side. In the event that the condenser is obstructed or flow is otherwise interrupted, the refrigerant temperature will rise, opening the contacts on the high temperature switch. This removes power from the compressor and turns it off. This switch requires manual reset. The user should not adjust it.
PS4	Refrigerant Low Pressure Temperature Switch	A low-pressure switch is incorporated on the suction side of the compressor. The switch opens contacts if the refrigerant suction pressure drops below normal operating pressure, interrupting power to the compressor and turning it off. This switch will auto-reset once the refrigerant pressure reaches the reset point. The user should not adjust it.

Schematic representations of safety device locations may be found in the Process and Instrumentation Diagram and on the Electrical Diagrams.

GAS COMPRESSOR UNIT		
PS2	Low Pressure Switch	A low-pressure switch is incorporated in the suction side of the gas compressor. The switch opens contacts if the gas pressure drops below normal operating pressure, interrupting power to the compressor and turning it off. This switch is auto-reset. The user should not adjust it.
PS3	High Pressure Switch	A high-pressure switch is incorporated in the discharge side of the gas compressor. The switch opens contacts if the gas pressure exceeds normal operating pressure, interrupting power to the compressor and turning it off. This switch requires venting of nitrogen to 0 psi and manual reset. The user should not adjust it.
TS2	Oil High Temp Pressure Switch	A high temperature switch shuts off the gas compressor when excessive oil temperature causes it to function. The compressor automatically restarts after the temperature cools and the switch resets.

TS3	Compressor Shell High Temperature Switch	A high temperature switch shuts off the gas compressor when excessive shell temperature causes it to function. The compressor automatically restarts after the temperature cools and the switch resets.
TS4	Gas High Temperature Switch	A high temperature switch shuts off the gas compressor when excessive gas temperature causes it to function. The compressor automatically restarts after the temperature cools and the switch resets.
TS5	Refrigerant High Discharge Switch	A high temperature switch shuts off the refrigerant compressor when excessive refrigerant temperature causes it to function. The compressor automatically restarts after the temperature cools and the switch resets.

⚠ CAUTION! Safety devices are installed on the 2XCL to help protect it from permanent damage. Some of the protective devices are self-resetting, with a system status output to the integrating equipment. When the system status indicates that a safety component has functioned, the integrating equipment should not enable operation until the cause of the fault is corrected.
If a protective device is triggered, the cause of the problem must be corrected before continuing to use the 2XCL. Please see Section 6.0 "Trouble-Shooting" or call the Polycold Service Department for assistance. *Bypassing or repeated resetting of a protective device may expose personnel and or the facility to hazards, permanently damage the equipment, and may void your warranty.*

TABLE A

CIRCUIT BREAKER AND FUSE PROTECTION			
Reference Designation	**Protection Provided**	**Rated Voltage And Amperage**	**Amperage Interrupting Capacity**
CB1	Overcurrent	460V / 16A	6,000 (See Note)
CB2	Overcurrent	460V / .5A	6,000
CB3	Overcurrent	24VAC / A	1,000
CB4	Overcurrent	460V / 16A	6,000
FU1	Overcurrent	230V / 2AT	
FU2	Overcurrent	230V / 2AT	
FU3	Overcurrent	230V / 0.4AT	
FU4	Overcurrent	230V / 0.4AT	
FU5	Overcurrent	230V / 0.4AT	
FU6	Overcurrent	230V / 0.4AT	
FU7	Overcurrent	230V / 0.4AT	

Note: Your electrical supply must also have enough capacity to handle the Rated Load Amps and should be provided through a circuit breaker rated with at least 10,000 AIC.

1.7 SAFETY TRAINING GUIDELINES

This chapter provides a summary of the safety information that is to be successfully conveyed to service personnel as part of their training on the POLYCOLD GAS CHILLER 2XCL. The training program is intended to ensure that any person who undertakes the service of the 2XCL can demonstrate competence to perform the required tasks safely. Accordingly, training required for each task includes, but is not limited to, the following:

1. A review of applicable safety standards and procedures as well as those presented in this chapter.
2. A review of maintenance and safety recommendations applicable to vendor supplied equipment.
3. An explanation of the purpose of subsystems and their operation.
4. An explanation of the specific tasks and responsibilities of each person (operator, service personnel, etc.) assigned to the Polycold GAS Chiller 2XCL equipment.
5. The person(s) (identified by name, location, and telephone number) to be contacted when required actions are beyond the training and responsibility of the person being trained.
6. Identification of the recognized hazards associated with each task.
7. Identification of, and appropriate responses to, unusual operating conditions.
8. Explanation of the functions and limitations of all safeguards, and their design characteristics.
9. Instructions for the functional testing (or other means of assurance) for proper operation of safeguarding devices.
10. Service personnel should understand the operation of process-related hardware interlocks, and the sequences of hardware operation that are executed automatically, as explained in this chapter.
11. The equipment should not be used without assuring correct operation of all connected facilities, especially fugitive emissions exhaust.
12. Service personnel should always assume that high voltage is present unless they have personally turned it off and locked it out.
13. The equipment should not be operated without all guards and safety devices in place.
14. The equipment should be shut down, locked-out, and should not operated while it is being maintained.
15. Users should not attempt to defeat, modify, or disable any of the equipment's safety interlock switches.
16. Only Brooks Automation trained service personnel should perform assembly, operation, disassembly, service, or maintenance of the Polycold GAS Chiller 2XCL equipment. A certified refrigeration technician must perform any work performed on the refrigeration portion of the system.
17. All safety related incidents or near misses should be reported to a supervisor or Brooks Automation Customer Service.
18. The user should carefully review and understand manufacturer provided material safety data sheets (MSDS) for materials used by this equipment.

1.8 LOCK-OUT, TAG-OUT PROCEDURE

LOCK-OUT TAG-OUT PROCEDURE, ELECTRICAL

1. Notify personnel you are performing a Lock-Out Tag-Out (LOTO).
2. Shut down the system following normal procedure: Remove power to the 2XCL. Verify that the compressor is off.
3. Isolate the system from the electrical supply by locking-out the breaker in the “OFF” position and notifying others with an identification tag.
4. Use a voltmeter to observe “0” volts in the area you will be working. Service can now be performed.
5. To re-energize, reverse these steps.

LOCK-OUT TAG-OUT PROCEDURE, GAS SUPPLY

1. Notify personnel you are performing a Lock-Out Tag Out (LOTO).
2. Isolate the system from the gas supply by closing the customer supplied gas connectors.
3. Verify the system is locked-out by slowly opening the gas inlet fitting on the 2XCL unit and allow the pressure to bleed down for 2 minutes—the flow should gradually slow to a stop.
4. Add lock and notification Tag to supply source shutoff.
5. To reestablish gas supply, reverse these steps.

2.0 INSTALLATION

2.1 SYSTEM DIAGRAMS

See Section 9 for Process & Instrumentation Diagram and Electrical Schematics

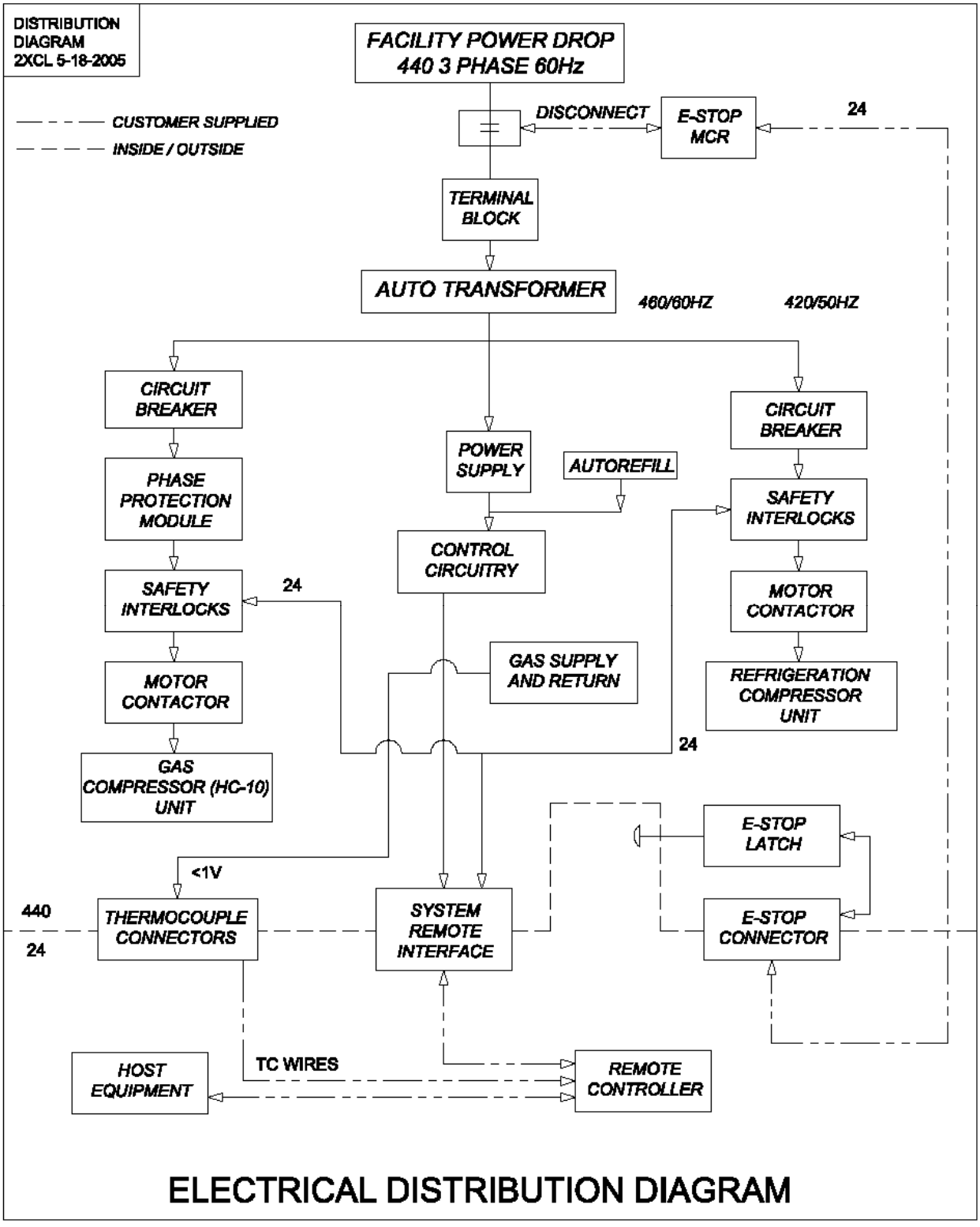


Figure 1: Electrical Distribution Diagram

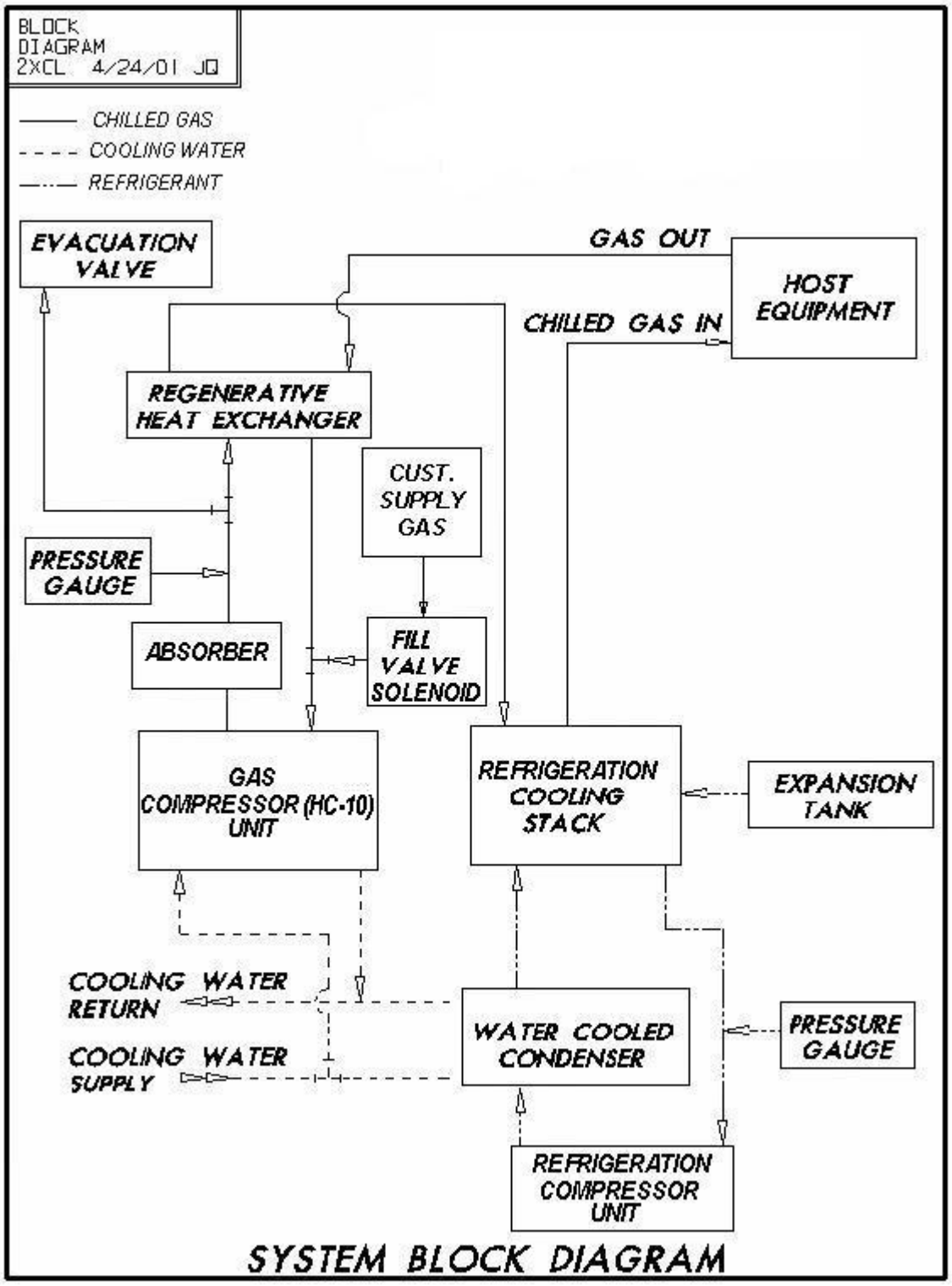


Figure 2: System Block Diagram

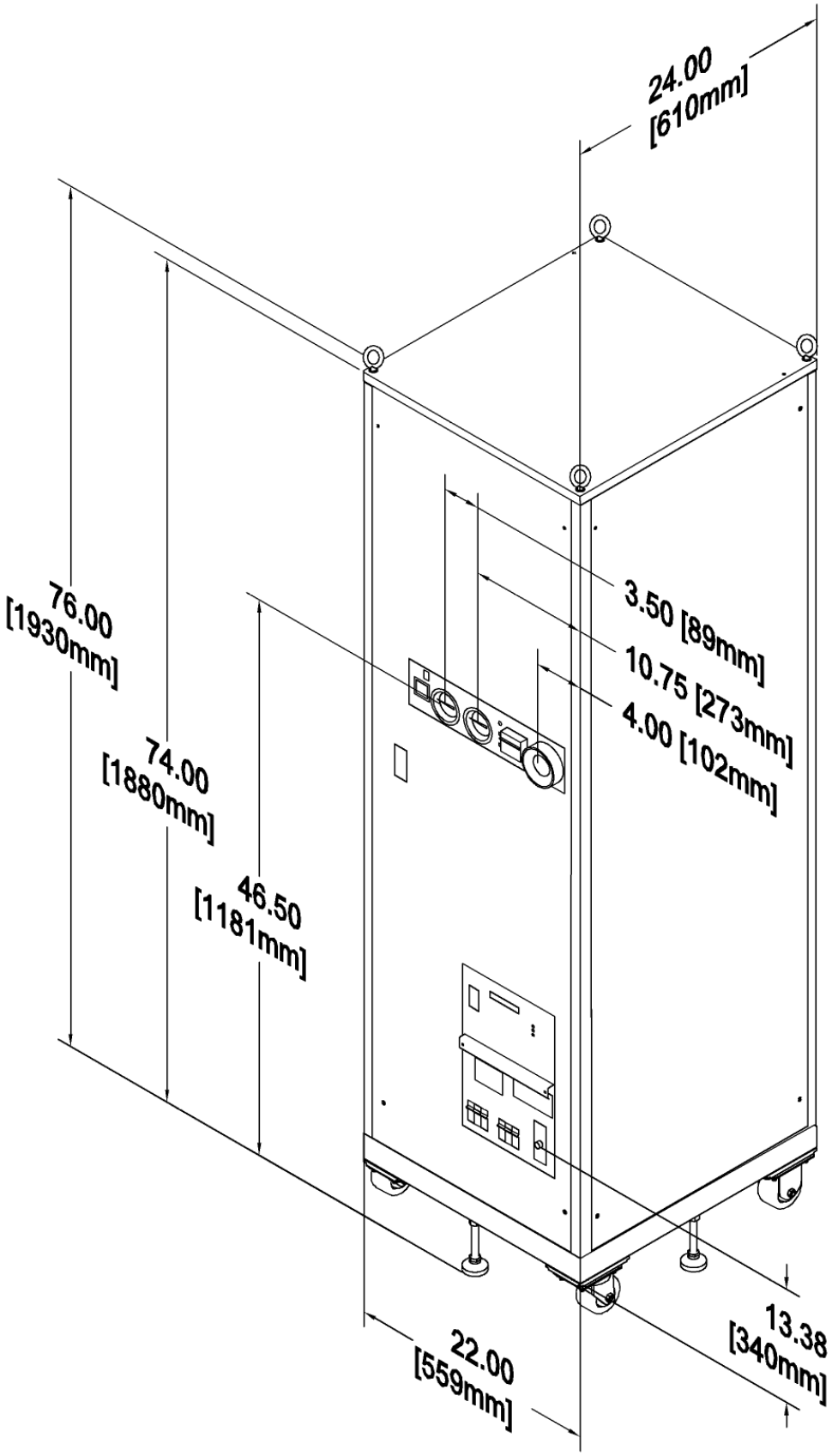


Figure 3: Dimensions, Front (version -06)

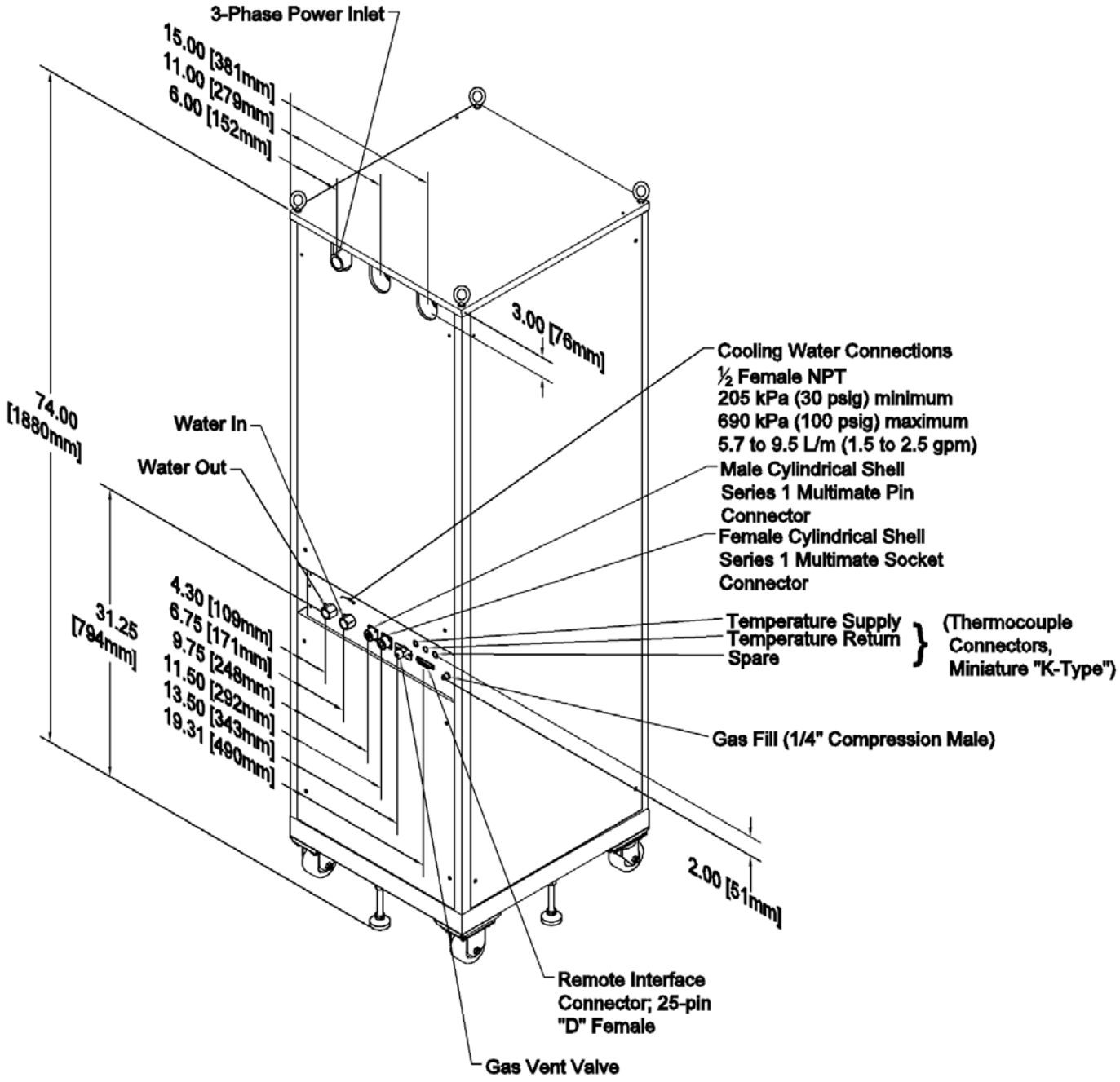


Figure 4: Dimensions, Rear (version -06)

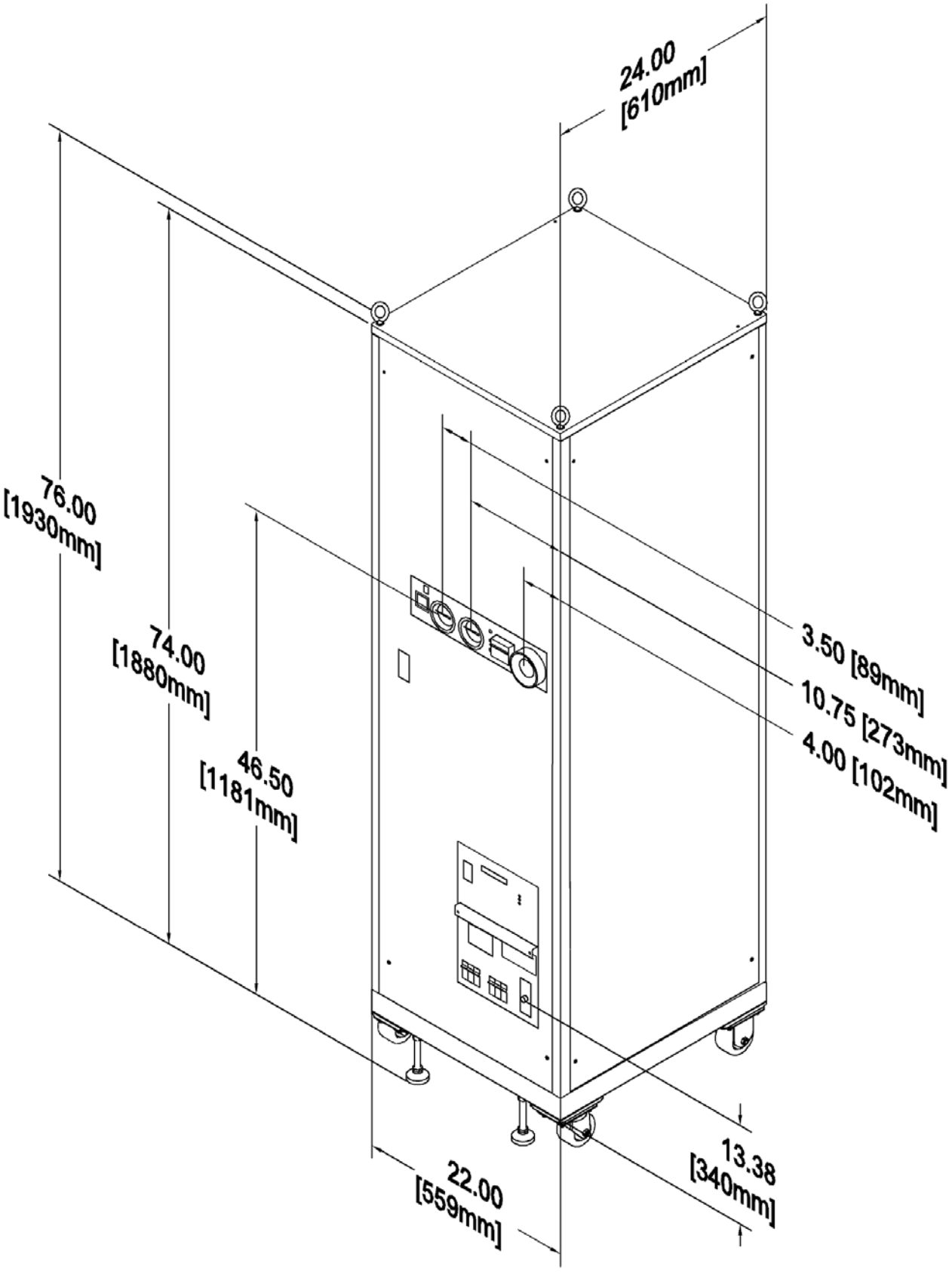


Figure 5: Dimensions, Front (version -07)

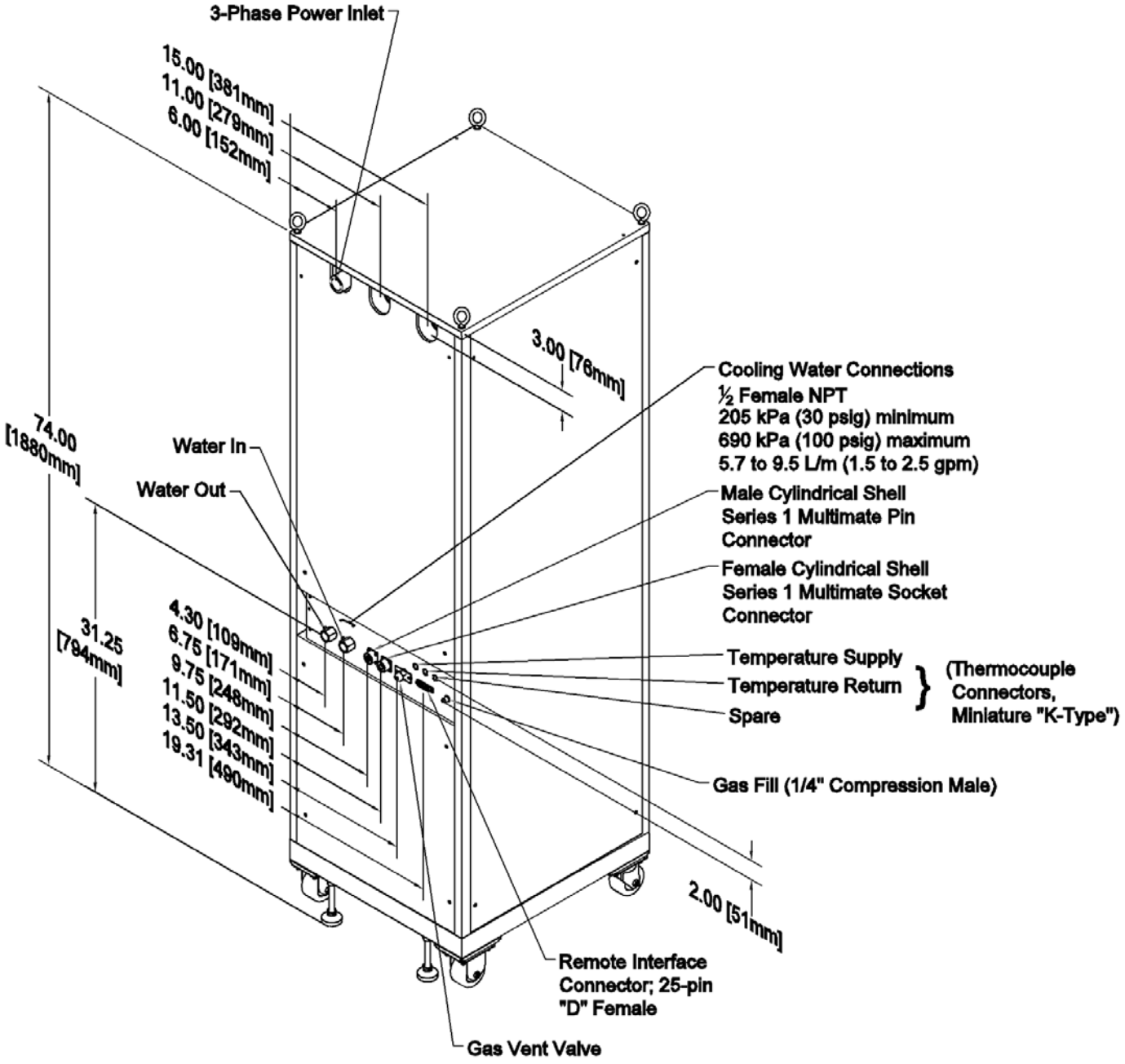


Figure 6: Dimensions, Rear (version -07)

2.2 ABOUT THE 2XCL

1. What it is and what it does

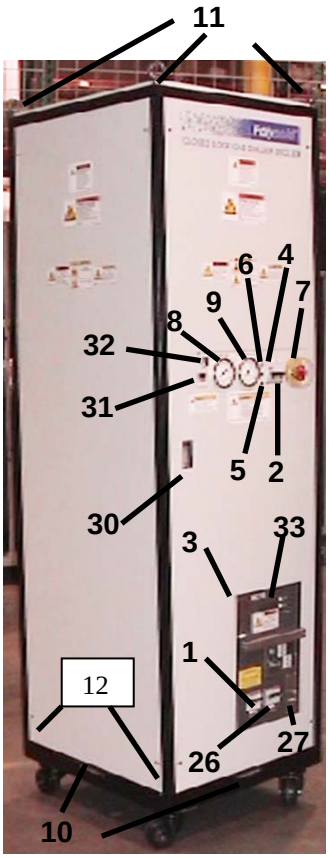
Polycold's *Cool Solutions*® 2XCL is a refrigeration unit that cools a stream of gas to ultra-low temperatures. It consists of two separate subsystems, the upper portion known as the Refrigeration Unit, which provides the cooling of the gas stream and the lower portion, which provides the secondary loop circulation of the gas stream. The Refrigeration Unit has a refrigerant circuit and a gas circuit.

The refrigerant circuit is located entirely within the 2XCL. The 2XCL's compressor circulates refrigerant in a continuous loop through the Polycold stack. The water-cooled condenser removes the heat of compression from the refrigerant by circulating cooling water through a coaxial coil, and the Polycold stack cools the refrigerant to ultra-low temperatures. (The refrigerant is a proprietary mixture of refrigerants provided by Brooks Automation.) The gas circuit consists of a continuous copper tube that runs through the refrigerant circuit. The gas is cooled as it runs through the Polycold stack.

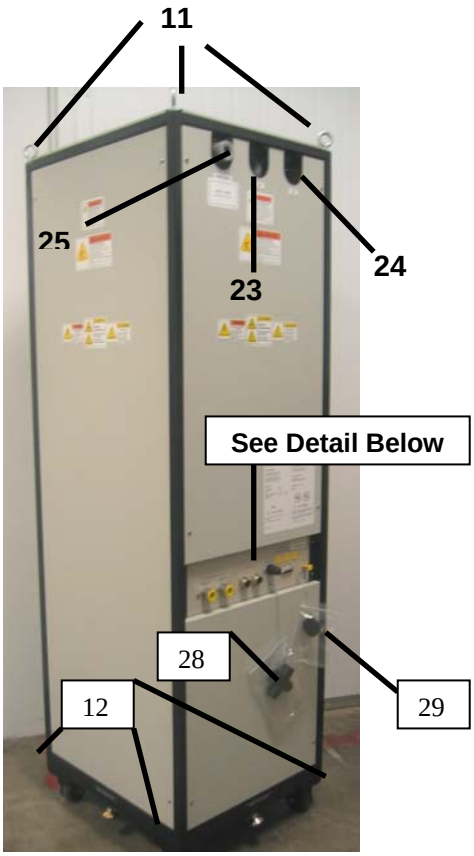
The gas compressor compresses customer supplied nitrogen or helium gas and uses a heat exchanger to cool it to room temperature. Oil separators and an oil adsorber reduce levels of oil and moisture in the gas stream to very low levels. A regenerative heat exchanger is used to assure that low pressure gas entering the compressor is within design limits of the gas compressor.

High pressure gas exiting the regenerative heat exchanger enters the Polycold stack. When the Polycold stack is cold, it chills the high pressure gas being supplied to the customer process. Low pressure gas returning from the process passes through the regenerative heat exchanger before entering the gas compressor.

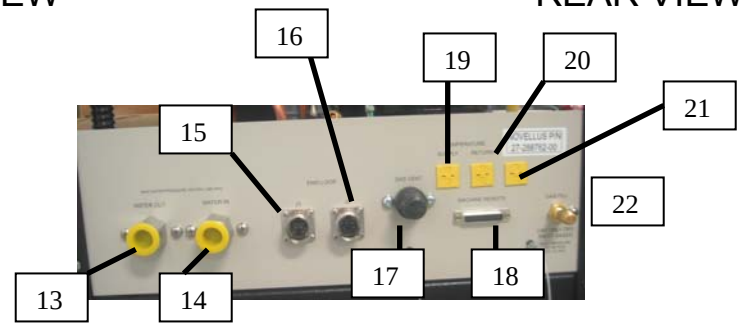
2. The 2XCL features (refer to the figures below)



FRONT VIEW



REAR VIEW



REAR VIEW DETAIL

.1 3. Unit Features:

1 **CONTROL VOLTAGE CIRCUIT BREAKER CB-1 (HC-10):** This switch protects a control voltage source. It must be closed to allow the unit to start. After initial start-up, switch must remain in the ON position if unit functions are to be accessed remotely.

2 **CB-4 REFRIGERATION UNIT:** This switch starts the Refrigeration unit. After initial start-up, ON/OFF functions of the unit may be accessed remotely.

3 **RUN INDICATOR HC-10:** Will be illuminated when gas compressor (HC-10) is running (and CB1 & CB2 are closed).

4 **RUN INDICATOR, REFRIGERATION UNIT:** Will be illuminated when power is applied, the CB4 switch is in the on position, and all systems are operating normally, indicating that the compressor contactor is closed (green LED).

5 **FAULT INDICATOR, REFRIGERATION UNIT**: Will illuminate if a problem such as over-pressure(s) or high temperature(s) should occur (red LED).

6 **LINE INDICATOR, REFRIGERATION UNIT AND GAS COMPRESSOR UNIT (HC-10):** Illuminates when line voltage is present and Gas Compressor circuit breaker (CB1 & CB2 are closed) (yellow LED).

7 **EMO (emergency machine off) BUTTON:** Used to power-down the unit(s) in the event an emergency situation should occur. This circuit is wired to a dedicated safe voltage supply and if activated all unit functions will cease and cause power contactors to open with the exception of power to this circuit. This button latches in the off position and must be rotated clockwise to disengage. Hazardous voltages remain in the unit from the point of electrical connection to the line side of the compressor contactors. The customer is responsible for removing power from the Polycold unit supply when the EMO circuit is activated.

8 **RECIRCULATING GAS SUPPLY GAUGE:** This dial represents supply pressure from the Gas Compressor Unit (HC-10) portion of the cooling unit to the host equipment. During normal operation, the dial typically reads 85 - 115 PSI.

9 **REFRIGERANT SUCTION GAUGE**: This dial represents internal Refrigeration Unit pressure (suction). During normal operation, the dial typically reads 25-35 PSI.

10 **SEISMIC ATTACHMENT POINTS**: These (4) 3/8-16 NC or ½ -13 NC threaded barrels are provided for seismic anchoring and can be used to install seismic anchor/jack screws.

11 **LIFTING EYES**: These lifting eyes (4) are provided as an accessory to safely lift the unit into place. These eyes are mounted in 3/8-16 NC threaded barrels.

⚠ WARNING!

LIFTING HAZARD (900 pounds (400 kg))
Failure to properly lift this device may result in severe injury or death.
Read the manual before lifting this equipment using the lifting eyes. Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component.

12 **CASTERS:** Enable the unit to be rolled into place for installation and for maintenance, etc….

13 **WATER IN CONNECTION:** ½ FNPT connection

14 **WATER OUT CONNECTION**: ½ FNPT connection

15 **EMO LOOP J1 CONNECTOR**: This is the FEMALE connector that allows access to the dedicated emergency machine off circuitry. It is wired in SERIES with the EMO button.

16 **EMO LOOP J2 CONNECTOR:** This is the MALE connector that allows access to the dedicated emergency machine off circuitry. It is wired in SERIES with the EMO button.

17 **VENT VALVE (V5):** This valve is piped to the high-pressure side of the HC-10 compressor.

18 **REMOTE CONNECTOR**: This connector provides switch contact opening for status of refrigeration and gas compressor units.

19 **THERMOCOUPLE CONNECTOR:** Miniature Type K, Supply temperature

20 **THERMOCOUPLE CONNECTOR**: Miniature Type K, Return Temperature

21 **THERMOCOUPLE CONNECTOR**: Spare

22 **GAS FILL PORT**: This is a ¼" compression fitting, used for charging the coolant loop. It is connected to a check valve to prevent pressurized gas from releasing through this fitting when it is open. It is piped to the suction side of the compressor. See fill procedures.

23 **GAS SUPPLY**: Bayonet adapter fits here, ½ Parker Ultraseal x Linde ½

24 **GAS RETURN**: Bayonet adapter fits here, ½ Parker Ultraseal x Linde ½

25 **POWER INLET**: Liquid tight conduit fitting, diam.: 1", 2.45" (L), 1.88" (W)

26 **CB 2 (MAIN CIRCUIT BREAKER**): This is the main circuit breaker for the gas compressor. After initial start-up, switch must remain in the "ON" position if unit functions are to be accessed remotely.

27 **CB 3**: Circuit breaker for control component.

28 **GAS VENT VALVE WRENCH**: This wrench is provided to open and close the gas vent valve (V5).

29 **REMOTE JUMPER:** The jumper is used to simulate the remote interface "GO" signals for the refrigeration chiller and the gas compressor unit. This jumper allows the 2XCL to be operated without being connected to the tool's remote user interface.

30 **FLOW INDICATING METER:** Provides indication of gas flow rate. This is not calibrated and is for indication only.

31 **AUTOFILL CONTROL (PS 5):** This display shows the gas suction pressure. It also is used to adjust settings for the autofill controller.

32 **FILL POWER SWITCH**: This switch is used to enable or disable the autofill controller.

33 **GAS COMPRESSOR UNIT (HC-10):** Fault Mode LCD Display.

2.3 INSPECT AND INSTALL THE 2XCL

⚠CAUTION!

No operator serviced parts within. Access restricted to trained service personnel only. Review specifications table (7.3) for facility requirements prior to installation.

Tools and materials needed:

1. Forklift (for overhead lift only), pallet truck, or overhead crane
2. Power cable from voltage source, suitably sized for this equipment
3. Wire strippers
4. #2 Phillips head screwdriver

1. Inspect and document any visible damage on the 2XCL crate.

2. Open the crate and inspect the 2XCL.

Notify the carrier immediately if you suspect the 2XCL was damaged during shipping.
Read the dial of the RECIRCULATING GAS SUPPLY GAUGE and record the pressure: _____ psig.
Read the dial of the REFRIGERANT SUCTION GAUGE and record the pressure: ____ psig.

3. **Determine if the seismic anchor/jack screws are installed. If not, install the seismic anchor/jack screws per the procedure shown in 7.5.**

4. **Remove the 2XCL from the crate using the top mounted lifting eyes.**

⚠ WARNING!
LIFTING HAZARD (900 pounds (400 kg))
Failure to properly lift this device may result in severe injury or death.
Read the manual before lifting this equipment using the lifting eyes. Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component.

⚠WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. The equipment should be removed from its shipping pallet by using the lifting eyes installed on top of the unit.

⚠ WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. Read the manual before moving this equipment using the casters. Move the equipment slowly and avoid rapid acceleration and deceleration. Apply force to move the system below the equipment center of gravity. Do not place yourself between the moving equipment and fixed obstructions.

⚠ WARNING!
Due to its weight, a lift truck or overhead crane is required to place and remove the 2XCL from the transport unit.

⚠ WARNING!
Due to its high center of gravity, care must be taken to avoid tipping the unit. 1) While transporting the pallet to which the unit is strapped and 2) While positioning the unit on its casters. (See illustration figures 3 & 4). The 2XCL should only be lifted from above, using its lifting eyes and a sling system.

5. Install 2XCL seismic anchor/jack screws. (See Appendix 7.5).
Place the 2XCL as close as possible to the desired location of your cold GAS stream. The 2XCL must remain vertical during transport and installation. The base frame of the 2XCL can be secured to the floor at the four locations labeled "Seismic Anchor Point". (See section 7 for installation instructions.)

6. Move the 2XCL unit to its installation location
The 2XCL unit should be lifted, using the lifting eyes mounted on top of the unit and a sling system; then moved to an area near its installation location. The 2XCL unit may be transported on its casters short distances on level floors within the installation location. DO NOT MOVE THE UNIT UP OR DOWN RAMPS ON ITS CASTERS!

⚠ WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. Read the manual before moving this equipment using the casters. Move the equipment on level floors only. Move it slowly and avoid rapid acceleration and deceleration. Apply force to move the system below the equipment center of gravity. Do not place yourself between the moving equipment and fixed obstructions.

⚠WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Maintain weight on casters at all times.

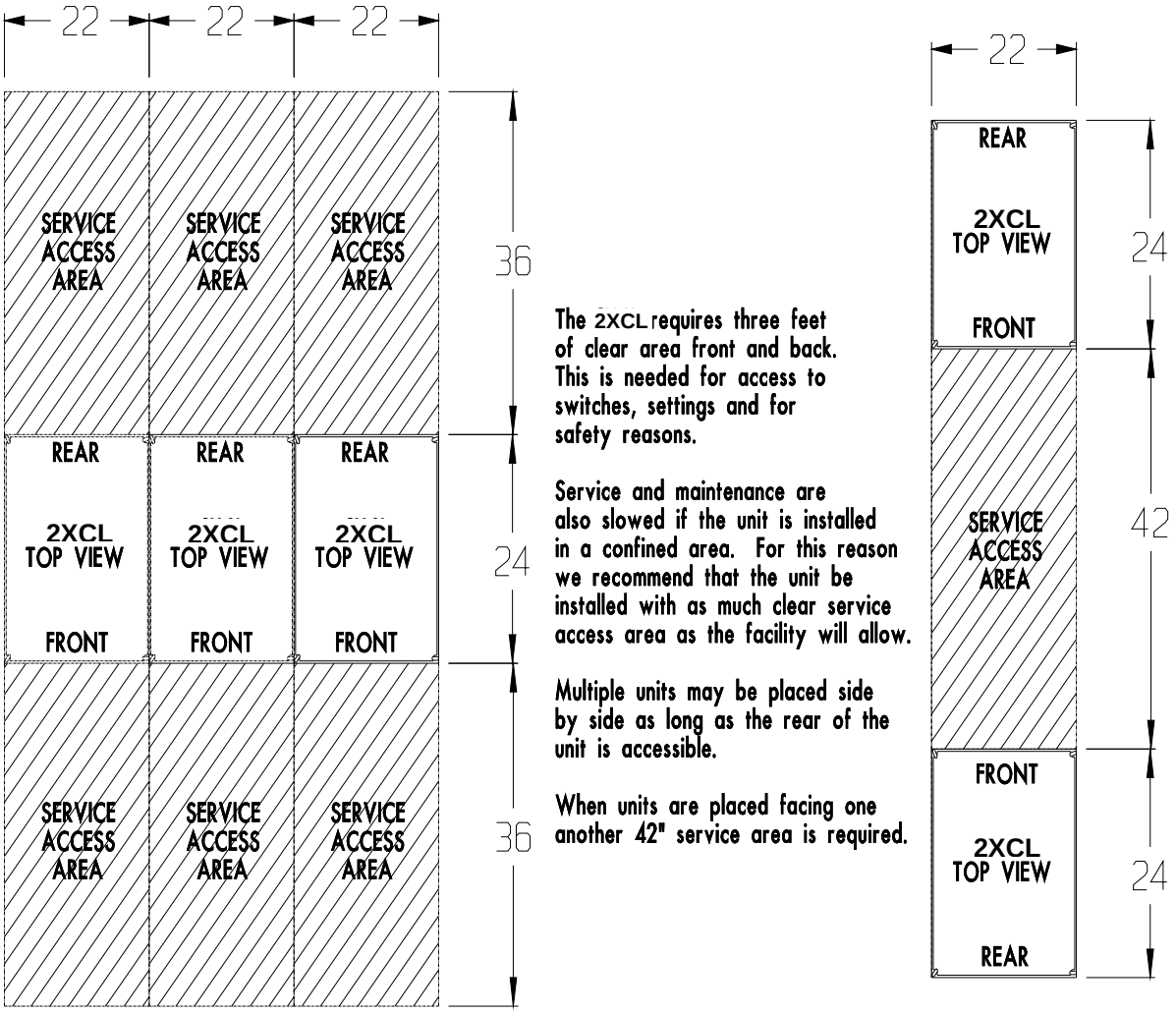

22
22
22
SERVICE ACCESS AREA
SERVICE ACCESS AREA
SERVICE ACCESS AREA
36
REAR
2XCL TOP VIEW
FRONT
REAR
2XCL TOP VIEW
FRONT
REAR
2XCL TOP VIEW
FRONT
24
SERVICE ACCESS AREA
SERVICE ACCESS AREA
SERVICE ACCESS AREA
36
The 2XCL requires three feet of clear area front and back. This is needed for access to switches, settings and for safety reasons.
Service and maintenance are also slowed if the unit is installed in a confined area. For this reason we recommend that the unit be installed with as much clear service access area as the facility will allow.
Multiple units may be placed side by side as long as the rear of the unit is accessible.
When units are placed facing one another 42" service area is required.
22
REAR
2XCL TOP VIEW
FRONT
24
SERVICE ACCESS AREA
42
FRONT
2XCL TOP VIEW
REAR
24

Figure 7: 2XCL "Footprint"

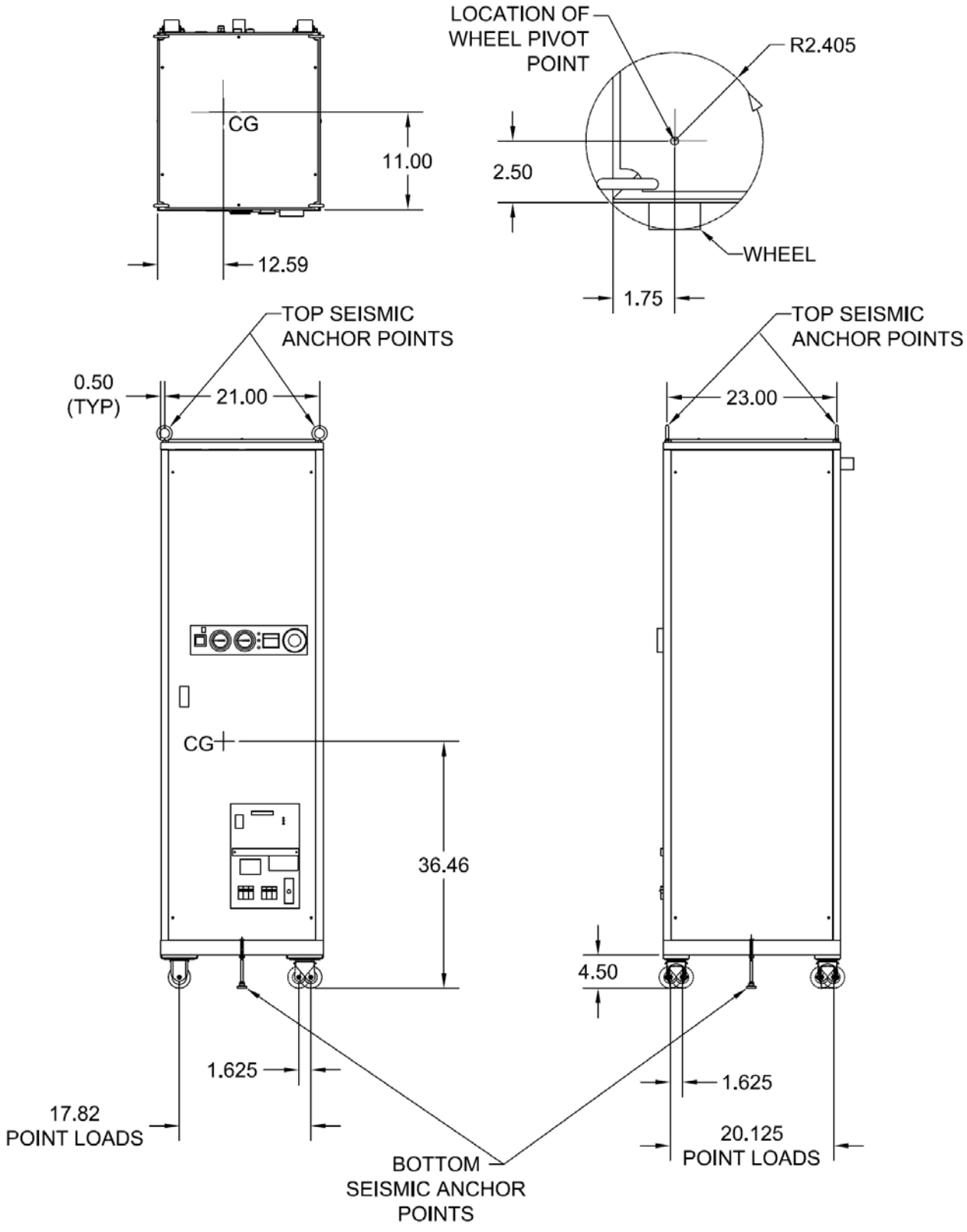
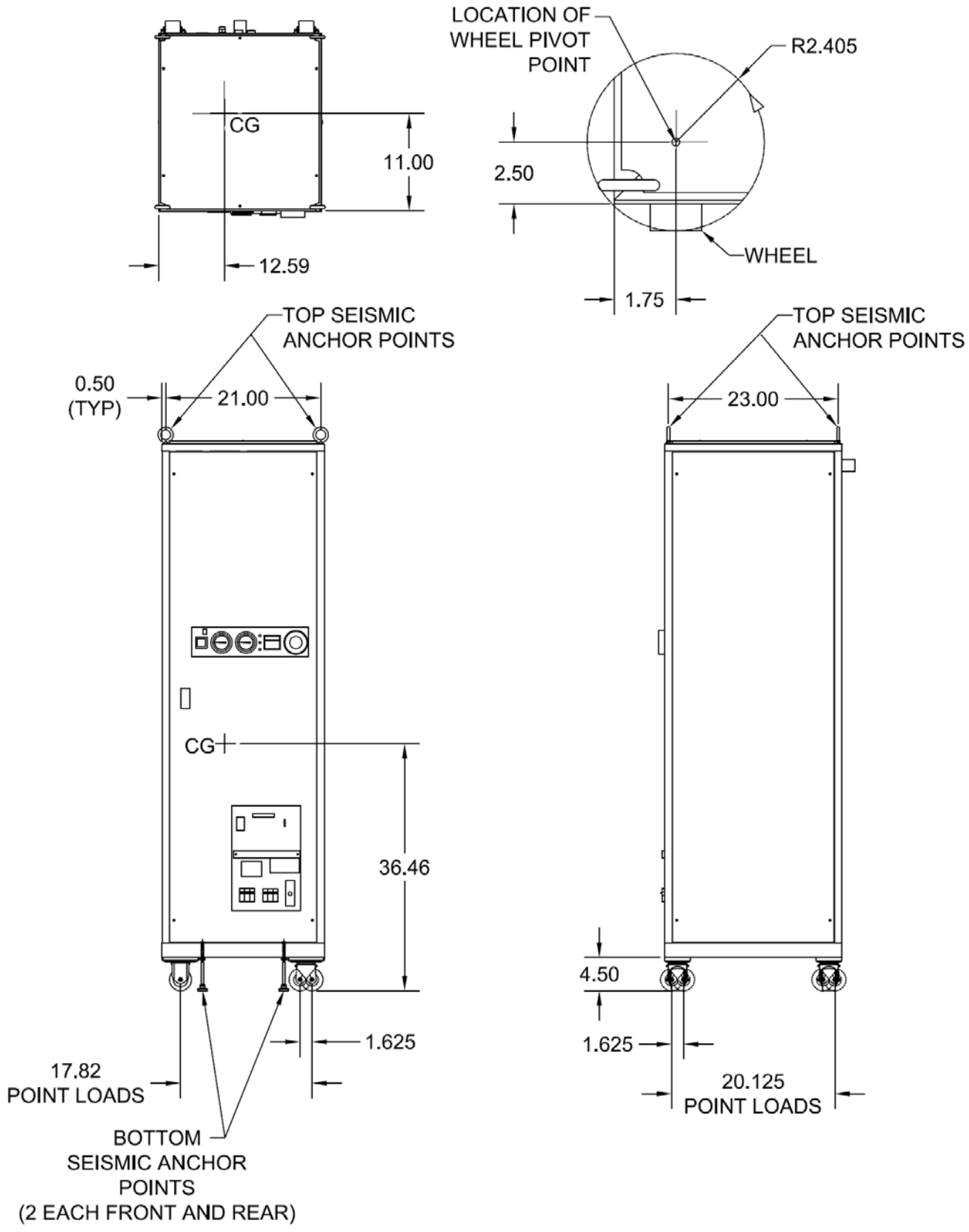


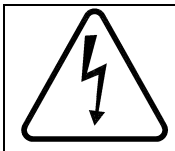
FIGURE 8: 2XCL(version -06) 440V Weight Distribution



MAXIMUM TILT ANGLE: LESS THAN 10°

FIGURE 9: 2XCL(version -07) 440V Weight Distribution

7. Connect the electrical power.



⚠ WARNING!
HAZARDOUS VOLTAGES
Electrical power to the 2XCL must be connected by qualified personnel, according to local codes.

⚠ WARNING!
HAZARDOUS VOLTAGE EXISTS AT ALL TIMES AFTER THE POWER IS CONNECTED. Only qualified electricians should perform electrical work. Power should be removed at the point of electrical connection, and locked-out following standard lock-out tag-out procedures. A lock-out device may be placed on the supply power circuit breaker (provided by others) or on the supplied electrical power plug.

The host equipment is to provide the main disconnect device and a circuit breaker that serves as the over-current protection for the electrical supply circuit.

Before connecting the 2XCL to your power source, verify the following:

- The disconnect device is readily accessible to the operator; located in sight and within 25' of the 2XCL; and clearly marked to indicate the equipment that it protects.
- The disconnect device locks in the de-energized position only; complies with IEC 947-1 and 947-3 standards; and meets the requirements of SEMI S2 section 17.
- Your actual voltage falls within the acceptable range listed in Table B.
- Your electrical supply has enough capacity to handle the Rated Load Amps and is provided through a circuit breaker rated with at least 10,000 AIC.
- The circuit protection must be adequately sized to operate with the 10 AWG internal wiring of the circuit.
- The supply power wiring must be sized in accordance with NFPA 79.
- The 2XCL is grounded according to SEMI S2 and CE requirements.

Note: The 2XCL is intended to be a subsystem of equipment and requires incorporation and protection by the host equipment Emergency Off (EMO) circuit. Refer to Electrical Schematic.

TABLE B

Nominal Voltage	Voltage/Phase/ Cycles	Acceptable Voltage Range	FLA	Fuse Size
440V	440/3Ø/60	396V- 484V	13.2A	16A
480V	480/3Ø/50/60	432V- 528V	12A	16A

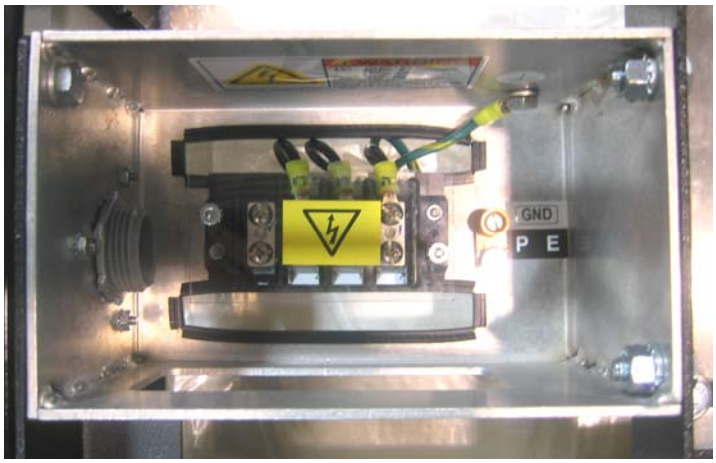
⚠ CAUTION!
Phase sensitive equipment. Clockwise rotation required. Incorrect rotation will prevent equipment operation.

The 2XCL is phase-sensitive and will not function if wired incorrectly. If the phase rotation of your power source is incorrect, an error will be displayed on the LCD (see section 6.6).

	⚠ CAUTION! **Status on Power Interruption/Restoration** The 2XCL system is not configured with onboard main circuit breaker. In the event of power interruption, the 2XCL ceases operation. On restoration of electrical power, the 2XCL system will restart when provided an enable signal. Placing the equipment in a safe shut-down condition requires removing the 2XCL Main Power cord connector.

Power Cord Installation

1. Remove top panel of the 2XCL unit.
2. Using a 5/16" nut driver or socket drive, remove the nuts from the plastic guard on the terminal block.
3. Remove the plastic guard from the terminal block (see photo below).

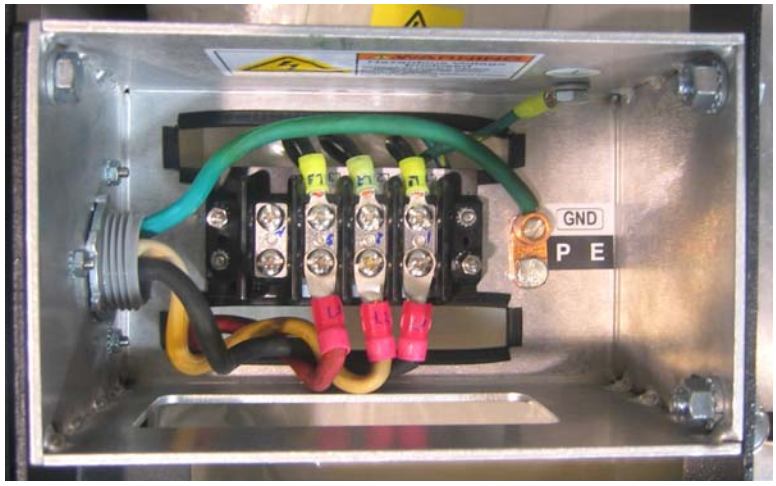


Terminal Block with Plastic Guard

Note: Use 10 AWG wire for your power cord.

4. Insert power cord through the liquid tight fitting located on the back-side of the 2XCL unit (see label 1 in "Power Inlet" photo below).

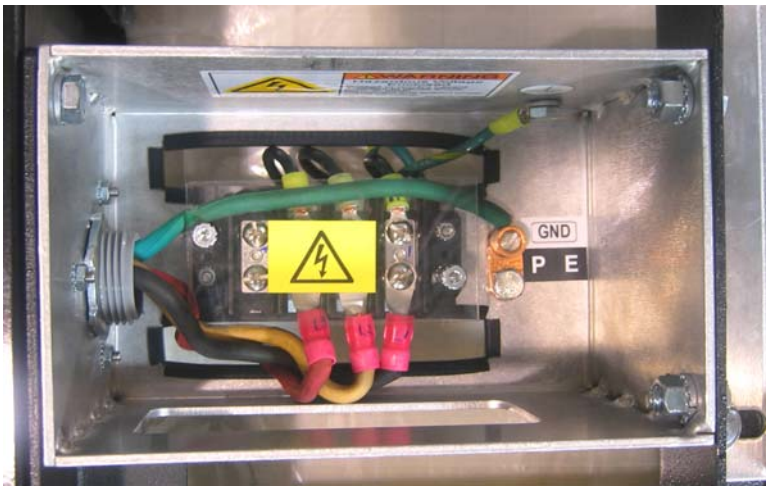
Power Inlet



Terminal Block with Power Cord Connected

5. Connect power cord to terminal block using the #10-32 screws provided.
6. Tighten screws on the terminal block using a torque wrench set to 20 IN-LBS.
7. Connect ground wire to terminal lug labeled "PE" (potential earth)/ "GND" and tighten screws securely (see photo labeled "Terminal Block with Power Cord Connected" above).

8. Reinstall plastic guard (see photo below).



Terminal Block with Power Cord Connected and Plastic Guard Installed

8. Installation of seismic anchorage brackets

Make sure seismic anchor/jack screws are installed (See Appendix 7.5 for more information). Install SEMI S2 approved seismic anchorage brackets. Install seismic anchorage brackets that secure the seismic anchor/jack screws firmly to the facility floor. Seismic anchorage brackets must be suitable to withstand a seismic load of 1400 lbs. per SEMI S2 requirements. (See semi.org for more information on S2 requirements.)

⚠WARNING!
TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Maintain weight on casters at all times.

9. 2XCL Safety Circuit Connector

⚠ WARNING!
THIS UNIT MUST BE WIRED INTO THE CUSTOMER'S SAFETY CHAIN.
HAZARDOUS VOLTAGE EXISTS AT ALL TIMES AFTER THE POWER IS CONNECTED. Only qualified electricians should perform electrical work. Power should be removed at the point of electrical connection, and locked-out following standard lock-out tag-out procedures. A lock-out device may be placed on the supply power circuit breaker (provided by others) or on the supplied electrical power plug.

The safety circuit connector provides the two following distinct functions: 1) Pressure switch fault status, either high (discharge side) or low (suction side) pressure; 2) Remote monitoring of the thermostat switches coupled to the discharge and liquid line temperatures.

10. 2XCL Thermocouple Connectors

The type k thermocouple connector provides remote temperature monitoring of the refrigerant temperature as it leaves the evaporator and the discharge temperature of the compressor.

RETURN - Measures the nitrogen temperature returning to the 2XCL from the customer process
SUPPLY - Measures the temperature of the nitrogen supplied by the 2XCL
SPARE – (optional) Customer supplied

11. Machine Remote Connector

The Machine Remote Connector is used for the remote (User) operation of the 2XCL. This connection enables User controlled start-up and provides the remote system with 2XCL contactor status signals. The 2XCL may be tested without connection to the User system by use of a jumper. Under normal operation the 2XCL should be under the control of the user remote system.

⚠ CAUTION! Safety devices are installed on the 2XCL to help protect it from permanent damage. Some of the protective devices are self-resetting, with a system status output to the integrating equipment. When the system status indicates that a safety component has functioned, the integrating equipment should not enable operation until the cause of the fault is corrected.

If a protective device is triggered, the cause of the problem must be corrected before continuing to use the 2XCL. Please see Section 6.0 “Trouble-Shooting” or call the Polycold Service Department for assistance. *Bypassing or repeated resetting of a protective device may expose personnel and/or the facility to hazards, may permanently damage the equipment, and may void your warranty.*

2.4 CONNECT THE COOLING WATER

Tools and materials needed:
1/2-inch (15 mm) standard pipe size wrench
Adjustable or open-ended wrench for fittings supplied by customer

1. Make certain your cooling water is adequate.

Measure the inlet water temperature. It must be 55-85° F (13-29° C). Make certain you have at least the minimum flow rate required for your water's temperature. See Table C "Cooling Water Flow Requirements".

Your cooling water may be warmer in the summer than in the winter. Cooling water lines within the 2XCL are not insulated. To prevent condensation inside the system enclosure, assure that the cooling water temperature is warmer than the dew point of the room in which the 2XCL is installed. Maximum working pressure of the cooling water circuit is 200 psig (1380 kPa).

Your cooling water should be clean and suitable for use in copper based heat exchangers. We recommend that you filter your cooling water if it is very dirty or has abrasives in it. Any chemical impurities in your cooling water must be compatible with copper.

2. Connect a supply and a drain line to the refrigeration unit.

Make certain you use the correct size pipe—see "Tools & Materials Needed" at the beginning of this section. For the 2XCL, the "COOLING WATER" connections have 1/2-inch female NPT fittings. Connect your supply line to the port labeled "IN". Connect your drain line to the port labeled "OUT". The cooling water must flow in this direction to properly cool the unit.

TABLE C

Refrigeration Unit	Water Inlet Temperature ° F (° C)	Minimum Flow Rate Gpm (L/min)	Pressure Drop Inside the Unit Psi (kPa)	Heat Rejection Btu/hour (kW)
2XCL	59 (15) 75 (24) 87 (30)	3 (5.4) 6 (10.8) 10 (36)	1.8 (13) 6.4 (44) 16.7 (115)	29,000 (8.5)

3. Verify that the water plumbing has no leaks.

⚠CAUTION!

EQUIPMENT DAMAGE

Do not turn on the unit until the cooling water has been connected and turned on.

2.5 INSTALL THE EXTERNAL GAS CIRCUIT AND GAS FILL LINE

Tools and materials needed:

1. Tubing or hoses with 3/8" I.D. or Vacuum Jacketed Lines (recommended)
2. Clean room compatible tubing insulation that is rated for extreme temperatures
3. Adhesive tape for fiberglass tubing insulation or equivalent
4. 1-1/2 inch channel lock pliers

1. Verify that the GAS source from the host equipment is adequate.

⚠ CAUTION! If your GAS contains moisture, the water will condense and freeze in the GAS circuit, and the 2XCL's performance will degrade as the GAS circuit becomes blocked. The 2XCL system is designed for use with inert Gases, having a dew point of lower than -80ºC (He or N2) only. Contact Brooks Automation prior to introduction of a GAS other than those specified.

⚠ CAUTION!

Do not exceed 90 PSI max supply pressure to the 2XCL! If this pressure is exceeded, the discharge pressure switch (PS3) may activate and cause a fault condition.

2. Install the external gas circuit.

Prior to installation, the lines and chuck need to have been conditioned to remove any moisture and contaminants. Evacuating these components via vacuum pump for a minimum of two hours is recommended. After conditioning, they need to be kept dry by back filling with nitrogen and sealing until they are ready for use.

Note: When attaching vacuum jacketed lines or Linde Male and Female bayonet adapters, special adjustments may be needed for rigid support of the lines. Both the supporting brackets are adjustable via the use of slotted holes. Difficulty may be experienced when fitting the Female line unless the outermost hanger clamp is removed completely and the inner clamp is loosened. After the knurled nut has been tightened (taking care not to put undue stress on the copper line), the hanger brackets can be tightened safely.

1. Assemble vacuum jacketed lines to the Polycold unit and the System Integrator making sure all connections are leak-tight,
   Note: It is recommended to leak check using a pressure decay method:
   a. Connect a source of dry nitrogen (dew point < -80° C) to the gas fill port.
   b. Verify that unit has power and that the autofill control is on. This can be confirmed by observing that PS5 is illuminated. If not, verify that the unit has power and that the autofill switch is in the "ON" position.
   c. Pressurize the unit (vacuum jacketed lines and chuck assembly to 85 psig through gas fill port). The autofill control will automatically pressurize the unit. This process takes 10 minutes or less.
   d. Observe/record reading on PS5. Switch the autofill switch to the "OFF" position.
   e. Test for 30 minutes: there should be no detectable leak.
      Notes: Small leaks (up to 20 psi loss per 24 hours, or 0.83 psi/hr, from 2XCL + lines) can be compensated for by using the autofill control. Leaks in excess of this must be eliminated.
   f. Switch autofill switch back to the on position.
   g. Do not use tracer gas (i.e., refrigerant) for leak detection due to possible damage to adsorber.
2. Purge the lines and chuck with nitrogen:
   a. Disconnect the return port bayonet connector at the Polycold unit.
   b. Purge the lines and chuck with nitrogen by turning on the nitrogen source and flowing approximately 5 to 10 SCFM for 30 minutes.
   c. Turn off nitrogen and reconnect the coolant gas outlet bayonet connector.
   d. Fill unit with nitrogen to 70 - 90 psig.

e. Verify that the return joint is leak-tight (pressure degrade or soap test, etc.…)

3. Turn on refrigeration compressor and wait at least 30 minutes to allow refrigerant to achieve equilibration inside the Polycold unit.
4. After the refrigeration compressor has run for at least 30 minutes turn on recirculation compressor and wait at least 30 more minutes to allow the recirculating nitrogen to cool the chuck and the vacuum jacketed lines.
5. Observe/record recirculation compressor pressure. It must be: 85 – 115 psig.
6. If the pressure is not as described in step above, then allow nitrogen to fill via the autofill control until target pressure is achieved.

Required Tools and Recommended Accessories:

- Nitrogen (dew point < -80° C, 70 - 90 psig)

Model 2XCL: Back of unit, cover removed

<u>If the Chuck table does not achieve cold enough temperatures</u>: Check the thermocouples with a K-type thermocouple read-out meter. The temperatures during normal operation are:

- Thermocouple connector at left-hand side, Chuck inlet (Polycold outlet temperature): Temperature should be colder than –65º C.

  Note: If the temperature is warmer than this, check the following specifications:

  - Refrigeration gauge during operation (suction pressure): 20 – 40 psig
  - Recirculating compressor gauge (discharge pressure): 85 – 115 psig

  If the above readings are within specification tolerances, turn off the refrigeration compressor and leave the N2 recirculating compressor on.

  Turn off the refrigeration compressor and run the gas compressor for one hour. Alternately, power-off the unit for at least 18 hours.

  - Refrigeration gauge when off and at ambient temperature (refrigerant “balance” pressure): 165 – 190 psi
  - Recirculation compressor gauge when off and at ambient temperature (gas circuit “balance” pressure): 70 – 90 psig

If the above readings are not within specification tolerances, it is necessary to call for refrigeration service.

2.6 EMERGENCY OFF CIRCUIT

The EMO button provided on the 2XCL is a dry contact switch that is electrically designed to be connected to customers EMO loop. When properly wired into the customer provided EMO loop, if the EMO button on the 2XCL or on the customers system is pressed, then the AC power to the 2XCL and the customer's system is shutdown.

3.0 OPERATION

⚠CAUTION!

If dry GAS is not being pumped though the GAS circuit, the 2XCL will condense water in the GAS circuit whenever the Polycold stack is cold. This can occur while waiting for the stack to cool down (after turning on the 2XCL) and up to four hours after turning off the 2XCL as well.

If the host equipment is sensitive to water, condensation can be avoided while not in use by plugging the open end(s) of the GAS circuit, or allowing a small amount (about 5 SCFH) of dry nitrogen to purge the GAS circuit.

⚠ATTENTION!

The refrigeration compressor control circuit features a time delay to remote signals. After sending a remote signal (on or off) to the refrigeration compressor, wait two minutes for this action to take place.

3.1 INITIAL START-UP

1. Verify that the unit is hardwired or plugged in and that line voltage is present. "LINE" light on the front of the unit will illuminate when the Main "ON/OFF" Rocker Switch (item 1 in "Unit Features") is in the on position.

2. Verify that the remote cable is connected to the remote connector on the back of the unit and that the EMO loop connections are connected.

3. Verify that "GAS" and "COOLING WATER" connections have been established and are leak-free.

4. Verify that the "Fill Power" switch is in the "ON" position.

5. Switch the CB1, CB2, & CB4 switch to the "ON" position.

6. The unit should be operational. Functions can be monitored through the remote connector.

7. Turn on the refrigeration compressor via the remote. Observe the upper Refrigeration Gas Pressure gauge (item 9 in "Unit Features"). It should show a drop in pressure. Initial pressure should be between 165 and 190 psi. Note initial pressure _____psi.

8. Wait approximately 30 minutes for the Refrigeration Unit portion of the unit to reach operating temperature.

9. Turn on the gas compressor via the remote.

10. If the system does not start, see Section 6. "Troubleshooting".

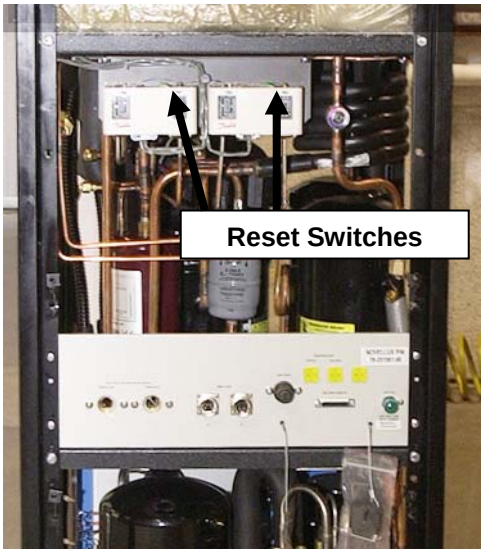
3.2 BAKE-OUT AND POST BAKE COOLING

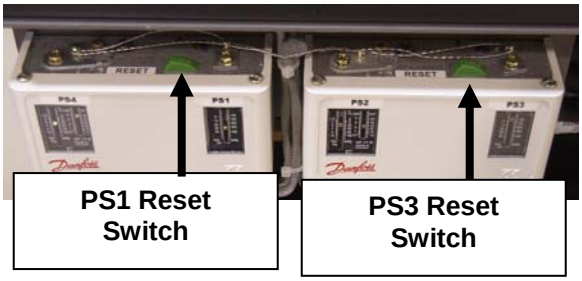
It is the responsibility of the operator/integrator to allow sufficient time after a bake-out cycle to bring the 2XCL down to temperature slowly, without subjecting the components of the integrated unit to thermal shock or stresses, which can cause premature failure.

After a bake-out cycle, operate the gas compressor only until the return temperature is < 32° C; then turn on the refrigeration chiller. User must control rate of chuck cooling so that it remains within the specification limits of the chuck.

3.3 RESETTING SAFETY INTERLOCKS AFTER FAULT

First, try to determine the reason behind the fault condition and affect the proper remedy. In normal operation the protective devices should not be triggered. However, should the need arise, these devices can be reset. (See interlock descriptions in Section 1.6). Refer to the following illustrations.





4.0 INSPECTION & MAINTENANCE

Inspect the *Cool Solutions*® 2XCL every six months or whenever moisture accumulates in the gas circuit, whichever occurs more often.

1. Verify that there is adequate water circulation through the condenser.

Check water flow requirements in section 2.4, Table C.
Performance specifications assume that water temperature is no higher than 29° C (85° F).

2. Verify that the insulation on the "GAS-OUT" line is adequate.

The insulation should be airtight. It should not be cracked or holding moisture. If necessary, disconnect power to the 2XCL and replace the insulation. (See Section 2.4 "Install the External GAS Circuit.")

3. Verify that the refrigerant circuit does not have a leak.

Disconnect power to the 2XCL and wait 24 hours.

The balance pressure should be within 7 psig of the pressure recorded in Section 2.3, "Inspect and Install the 2XCL," Step #1. If the pressure is lower, the refrigerant circuit may have a leak.

4. Remove moisture from the GAS circuit.

Moisture may accumulate in the GAS circuit and will freeze when the 2XCL is operating, which may restrict GAS flow.

To purge moisture from the gas line, follow the instructions in Section 2.5 of this document. Allow the GAS supply from the host equipment to flow (at about 50 SCFH) through the GAS circuit until the exiting GAS is dry. The exiting GAS should be dry in about 10 minutes.

⚠CAUTION!
If the host equipment is sensitive to water, condensation can be avoided while the system is not in use by plugging the open end(s) of the GAS circuit, or allowing a small amount (about 5 SCFH) of dry nitrogen to purge the GAS circuit.

5. Adsorber (Molecular Sieve) Replacement

The adsorber must be replaced as a part of routine maintenance after every 10,000 hours of operation of the Gas Compressor.

Replacement part numbers:

Polycold Part No# 840208-00
SHI-APD Part No# 460962

1. Shut down system and allow N2 circuit to reach room temperature.
2. Vent gas using the refrigeration valve (V5) at the rear of the unit.
3. Remove external and internal covers to allow access to molecular sieve.
4. Loosen sieve inlet and outlet fittings.
5. Remove two (2) securing screws.
6. Remove adsorber.
7. Place new adsorber on bottom plate and secure with two (2) screws.
8. Connect inlet and outlet gas lines.
9. Charge with gas and check for leaks.
10. Replace covers and run unit.

5.0 DISCONNECTION, STORAGE, AND RESHIPMENT

1. The 2XCL should be transported using its original shipping materials. If these materials are unavailable, please contact Polycold for support.

2. Shut down power to the 2XCL and allow the system to reach ambient temperature (allow 24 hours to reach thermal equilibrium); or turn off the refrigeration compressor unit, and run the gas compressor unit for one (1) hour to warm up the lines and the chuck.

3. Disconnect electrical power from the 2XCL system.

4. Disconnect the gas supply line.

5. Vent gas from the Gas Compressor Unit using the refrigeration valve (V5) at the rear of the unit.

6. After the gas has vented, disconnect the Coolant Gas Bayonet connectors (23, 24).

7. Cap the Bayonet connectors to prevent diffusion of moisture into the system.

8. Turn off the cooling water lines and disconnect.

9. Use compressed air to blow out remaining water from the lines.

10. Remove the insulated interconnection plumbing from the transport path of the 2XCL unit.

11. Verify that the casters are firmly affixed to the base of the 2XCL unit.

12. Raise the seismic anchor/jack screws so that the weight of the unit rests on the casters. Slowly transport the unit to an area where it can be lifted onto the pallet.

⚠ WARNING!

TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE
Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. Read the manual before moving this equipment using the casters. Move the equipment slowly and avoid rapid acceleration and deceleration. Apply force to move the system below the equipment center of gravity. Do not place yourself between the moving equipment and fixed obstructions.

13. Using the eyebolts on the top of the 2XCL unit, lift the system, and, depending on the crate design, remove its seismic anchor/jacks screw.

	⚠WARNING! TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE Over-tipping (leaning) this device may cause it to fall over resulting in severe injury or death. The equipment should be removed from its shipping pallet by using the top installed lifting eyes.

	⚠ WARNING! LIFTING HAZARD (900 pounds (400 kg)) Failure to properly lift this device may result in severe injury or death. Read the manual before lifting this equipment using the lifting eyes. Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component.

14. Lower the 2XCL unit onto its original shipping pallet. Verify that the casters carry no weight when the unit is in the crate. Failure to do so may cause damage to the casters and void your warranty. Assemble the crate around the 2XCL unit and transport to its new location.

6.0 TROUBLESHOOTING

⚠CAUTION!

If dry GAS is not being pumped though the GAS circuit, the 2XCL will condense water in the GAS circuit whenever the Polycold stack is cold. This can occur while waiting for the stack to cool down (after turning on the 2XCL) and up to four hours after turning off the 2XCL as well.

If the host equipment is sensitive to water, condensation can be avoided while not in use by plugging the open end(s) of the GAS circuit, or allowing a small amount (about 5 SCFH) of dry nitrogen to purge the GAS circuit.

⚠ATTENTION!

The refrigeration compressor control circuit features a time delay to remote signals. After sending a remote signal (on or off) to the refrigeration compressor, wait two minutes for this action to take place.

Contact your local sales representative or the Brooks Automation Service Department if you need any assistance troubleshooting or repairing your 2XCL. Be sure to do this if the compressors have an internal problem, if the refrigerant circuit has a leak, or if the cooling water circuit is obstructed. Also, see Section 3.3 for resetting safety limit switches.

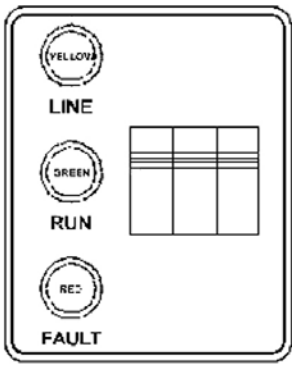
6.1 GENERAL TROUBLESHOOTING MATRIX

Problem	Possible Cause	Corrective Action
Unit does not start, and there are no indicating lights illuminated on the unit.	EMO tripped on user system or 2XCL	Determine if EMO is tripped, if this is the reason, make sure it is safe; then reset and restart the system.
	No power to system.	Confirm that upstream power source is adequate. Reconnect the equipment. Apply power.
	Inadequate power to system.	Correct power problem and supply adequate power to the equipment. For power requirements, see table B in Polycold's 825105 *Customer Instruction Manual*.
Compressor(s) do not start (and make(s) no noise).	No electrical power If CB4 stays in the "ON" position, verify the following: • Refrigeration Unit has power. • Power supply is adequate. • CB1 and CB2 are in the "ON" position, CB3 is not tripped. If CB4 has tripped to the "OFF" position, verify the following: • Power supply is adequate.	Check that power source is on and the power cord is connected. • Confirm that the EMO switch is in the extended (normally closed) position. • EMO switch on the 2XCL and the user system is in the correct (ON) position. • Correct power problem and supply adequate power to the equipment. For power requirements, see table B in Polycold's 825105 *Customer Instruction Manual.* • Verify transformer is wired to correct taps. See section 2.2, step 7 in Polycold's 825105 *Customer Instruction Manual.* • If power is within specification, wired correctly, and breaker is tripping, call your certified service agent or Polycold.
Unit has power and both Refrigeration and Gas compressors are **not** operational.	Customer user interface not connected properly.	Disconnect user interface and install remote jumper; if compressors start, troubleshoot tool side of user interface. If either compressor fails, see section 6.2 or 6.3.
Refrigeration compressor **not** operating, Gas compressor **is** operating.		See section 6.2.
Gas compressor **is** operating, Refrigeration compressor **is not** operating.		See Section 6.3.

Problem	Possible Cause	Corrective Action
Refrigeration and Gas compressor both operating but cooling is inadequate.	Line obstruction or Autofill not working (See section 6.5).	Verify nitrogen source is dry (dew point of –80° C or less. Verify nitrogen suction pressure is greater than 12 (i.e., red Autofill led reads 12 or minimum Autofill setting. See section 3.4) and nitrogen discharge pressure is less than 140. Check evidence of flow via mechanical flow meter on front panel of unit.
(AND) Nitrogen flow has been checked and is OK.	Incorrect vacuum jacked lines.	Check against tool OEM specifications.
	Gas supply temperature incorrect.	• Check gas supply temperature; if colder than –70°, check Chuck heater control. • If warmer than –70° and refrigeration compressor has been in operation for greater than one hour, record refrigeration suction pressure and call your certified service agent or Polycold.
	• Inlet gas flow is not within specification. • Gas circuit has a leak. • Water circulation through the condenser is inadequate. • The refrigerant circuit has a leak.	See Polycold manual 825105 section 4.0 Inspection & Maintenance.
Compressor hums or starts, and then stops.	Electrical connections may be out of phase.	Check for phase error signal on LCD display.
	The circuit breaker may have been triggered, or the thermal overload protector on the compressor may be cycling the compressor on and off. Verify the following: • The compressor(s) are not overheating. • The power supply (voltage) is adequate.	Verify the supply voltage meets specification (see Table B) and that the transformer taps are properly configured (see section 2.2 step 7).
2XCL makes unusual noises.	Verify the following: • There are no loose parts. • A tube is not rubbing or rattling against another surface.	Look for loose parts and / or other conspicuous tubes or rattling components.

6.2 REFRIGERATION COMPRESSOR FAULT MODES

Indicator Lamps Based Troubleshooting Matrix (**Normal Modes**)

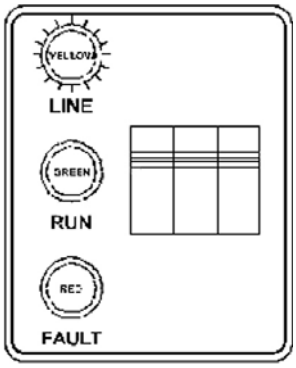


REFRIGERATION UNIT

STATIC MODE 1 (UNIT NOT RUNNING - NO LINE POWER PRESENT)

INDICATOR	COLOR	STATUS
LINE	YELLOW	OFF
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = NA, CB1 & CB2 = ON

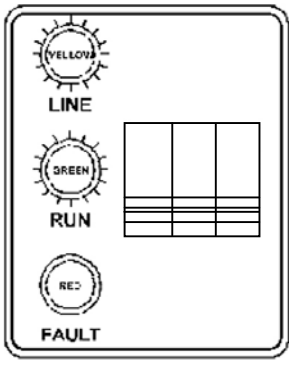


REFRIGERATION UNIT

STATIC MODE 2 (UNIT NOT RUNNING – LINE POWER PRESENT AND MAIN ON/OFF SWITCH FOR GAS COMPRESSOR IS IN ON POSITION – REFRIGERANT COMPRESSOR REQUIRES USER REMOTE SIGNAL TO START)

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = ON, CB1 & CB2 = ON



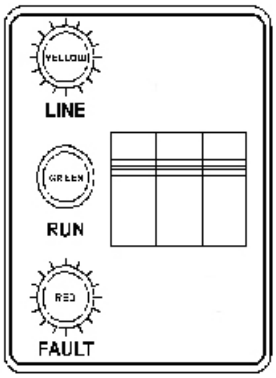
REFRIGERATION UNIT

RUN MODE (UNIT RUNNING - SYSTEM OK)

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	ON
FAULT	RED	OFF
POWER		ON

CB4 = OFF, CB1 & CB2 = ON

Indicator Lamps Based Troubleshooting Matrix (**Fault Modes**)

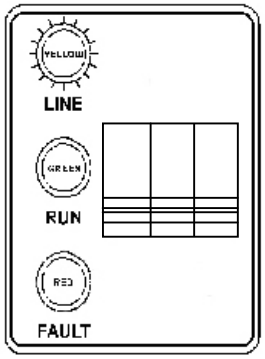


REFRIGERATION UNIT

FAULT MODE 1 **(NOT RUNNING – PRESS/TEMP TRIP OCCURRED)**

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = ON, CB1, CB2 & CB3 = ON

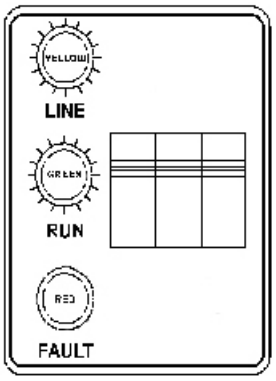


REFRIGERATION UNIT

FAULT MODE 2 **(NOT RUNNING - CIRCUIT BREAKER CB4 TRIPPED)**

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = OFF, CB1, CB2 and CB3 = ON

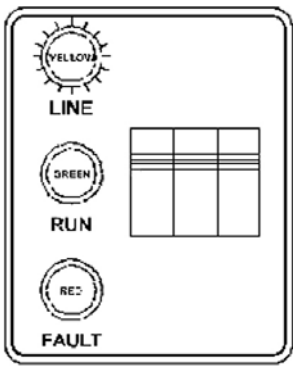


REFRIGERATION UNIT

FAULT MODE 3 **(NOT RUNNING - COMPRESSOR OVERLOAD TRIPPED)**

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = ON, CB1, CB2 and CB3 = ON



REFRIGERATION UNIT

FAULT MODE 4 (UNIT NOT RUNNING – LINE POWER PRESENT AND MAIN ON/OFF SWITCH FOR GAS COMPRESSOR IS IN ON POSITION – CIRCUIT BREAKER CB3 IS TRIPPED

INDICATOR	COLOR	STATUS
LINE	YELLOW	ON
RUN	GREEN	OFF
FAULT	RED	OFF
POWER		OFF

CB4 = ON, CB1 & CB2 = ON CB3= OFF

6.2.1 REFRIGERATION UNIT INDICATOR LAMP FAULT CONDITIONS EXPLAINED

Problem	Possible Cause	Corrective Action
STATIC MODE 2 Refrigeration compressor is not working AND CB4 is ON and Line light is ON.	Timer delay relay is still active.	Wait two minutes for timer to time-out. Check timer relay settings if on delay is in excess of 2 minutes.
	User remote signal not provided.	Verify user remote signal is provided on pins 1 and 2. If user remote fails to start compressor but the remote jumper does, inspect condition of pins 1 and 2 for possible damage. The signal may be absent for several reasons, including incorrect wiring at the integrating equipment, incorrect controls programming by the integrating equipment, or correct function of the integrating equipment (in the event of unit fault resulting in control-interrupt latching).

Problem	Possible Cause	Corrective Action
FAULT MODE 1: Refrigeration compressor not working, CB4 is **ON AND** fault light is **ON**.	Refrigerant Pressure Switch (High Side) (PS1) is tripped due to:	**PS1 is a latching switch** – Manual reset required.
	• Excess load	Excess load: Verify nitrogen compressor pressures (typically 19 – 23 psi during operation – lower values used with long lines) are within control parameters of autofill control (see sections 6.4 to 6.8). If not, troubleshoot autofill control. Verify gas return temperature is below 32° C. During post bake-out, the gas compressor can be used, but the refrigeration compressor must remain off until the return temperature is below 32° C).
	• Cooling water flow or temperature out of specification	Verify cooling water flow and temperatures are within specifications of Table C.
	• Problem with refrigerant charge	Verify condenser has not accumulated excessive scale. Call your certified service agent or Polycold.
	Refrigerant Pressure Switch (Low Side) (PS4) is tripped due to: • Loss of refrigerant charge	**PS4 is a non-latching switch.** Call your certified service agent or Polycold. Before calling, turn on the gas compressor for 30 minutes to warm the refrigerant system. Record the refrigerant suction pressure and check against installation records.
	Temperature switch trip (TS1) • Cooling water flow or temperature out of specification	**TS1 is a non-latching switch** Verify cooling water flow and temperatures are within specifications of Table C. Verify condenser has not accumulated excessive scale.

Problem	Possible Cause	Corrective Action
FAULT MODE 2: Refrigeration compressor not working AND CB4 is OFF.	Incorrect voltage or transformer tap configuration.	Verify the supply voltage meets specification (see Table B) and that the transformer taps are properly configured (see section 2.2, step 7).
	Internal short in high voltage wiring.	Call your certified service agent or Polycold.
	Locked rotor condition.	Call your certified service agent or Polycold.
FAULT MODE 3: Refrigeration compressor not working AND CB4 is ON AND the Fault light is not lit, AND CB1, CB2 and CB3 are on.	Incorrect voltage or transformer tap configuration.	Verify the supply voltage meets specification (see Table B) and that the transformer taps are properly configured (see section 2.2, step 7).
	Internal motor failure.	**The internal overload is a non-latching switch.** Call your certified service agent or Polycold.
FAULT MODE 4: Refrigeration compressor not working AND CB4 is ON AND the Fault light is not lit AND CB3 is Off.	Electrical short in the safety circuit.	Call your certified service agent or Polycold.

6.3 GAS COMPRESSOR UNIT (HC-10) FAULT MODES

Circuit breakers and LCD Display:

LCD Display

CB1 **CB2** **CB3**

CB4

Gas compressor cycling: If the gas compressor cycles on and off without any indicated fault, reset circuit breaker 2 ("**CB2**").

6.3.1 GAS COMPRESSOR UNIT TROUBLESHOOTING MATRIX

Problem	Possible Cause	Corrective Action
Gas compressor not working AND CB1 AND/OR CB2 are OFF.	Overcurrent in control circuit or compressor current.	Verify the supply voltage meets specification (see Table B) and that the transformer taps are properly configured (see section 2.2, step 7). Call your certified service agent or Polycold.
Gas compressor not working (Run light is OFF); CB1, CB2, and CB3 are ON; AND there are no faults codes displayed on the LCD.		Verify the supply voltage meets specification (see Table B) and that the transformer taps are properly configured (see section 2.2, step 7). Call your certified service agent or Polycold.
Gas compressor runs with remote jumper but NOT with tool remote signal.	Remote/Control Signal not present. Damaged pins on remote connector.	Verify user remote signal is provided on pins 5 and 6. If user remote fails to start compressor but the remote jumper does, inspect condition of pins 5 and 6 for possible damage. The signal may be absent for several reasons, including incorrect wiring at the integrating equipment, incorrect controls programming by the integrating equipment, or correct function of the integrating equipment (in the event of unit fault resulting in control-interrupt latching).
"PHASE SEQ ERROR" ON LCD Display.	Wrong phase for power.	**This fault is electronically latched. To reset, cycle CB1.** Provide clockwise rotation for the supply power.

Problem	Possible Cause	Corrective Action
"MOTOR TEMP ERROR" ON LCD DISPLAY	One of several faults are possible see below:	
"MOTOR TEMP ERROR" ON LCD DISPLAY. **Due to:** **Hi Pressure (PS3) Fault.**	Excess gas discharge pressure due to: Excessive flow. Flow restriction in line.	**PS3 is latched electronically and mechanically – Requires manual reset and reset of CB1.** Scroll through LCD display – verify that no other faults are present. If no other faults present, follow the steps below:

1. Vent gas to achieve 0 psi using the refrigeration valve (17) at the rear of the unit.
2. Press the green switch on "PS3" to reset it.

3. Fill the gas system with a fresh charge of dry gas (70 psig min., 90 psig max.).
4. Restart the system, and if the high pressure switch trips, check for restrictions in the customer installed lines.

6.3.1 GAS COMPRESSOR UNIT TROUBLESHOOTING MATRIX (CONTINUED)

Problem	Possible Cause	Corrective Action
"MOTOR TEMP ERROR" ON LCD DISPLAY. **due to:** **Low Pressure (PS2) Fault.**	Low suction pressure in gas line due to:	**PS2 is latched electronically – reset "CB1" to clear fault (after resetting switch).** Scroll through LCD display – verify no other faults are present. To reset the switch, the nitrogen pressure must be raised above 70 psi then cycle CB1 to reset electronics.
	Low nitrogen charge/gas leaks.	With gas compressor off check the recirculating gas pressure gauge (item 8) which should show a minimum pressure of 70 psi. If below 70 psi, check for: • Adequate nitrogen fill source (70 psi minimum) • Leaks in lines
	Mechanical obstruction in line.	Kinked lines or other obstructions in line. Verify nitrogen supply meets required dryness (dew point < -80° C). (**Note:** Small leaks can be compensated for with the internal autofill control switches (33) on and PS5 (32) set properly (see section 7.6) verify gas is connected to gas fill port (22) and that its supply pressure is adequate; verify customer installed lines are not blocked.
	Autofill control malfunction.	See autofill troubleshooting section 6.4 and 6.5.
"Water Temp Err" OR "Water Flow Err" **ON LCD DISPLAY** **(and compressor runs).**	Incorrect water flow or temperature caused TS3 or TS4 to trip.	**TS3 and TS4 are electronically latched (after resetting switch).** Scroll through LCD display to verify that no other faults are present. If fault(s) present, determine which one(s) occurred. To reset, allow 30 minutes for thermostats to cool and reset. Then cycle CB1 to reset electronics. Verify water flow and temperature are within specification (see Table C).

Problem	Possible Cause	Corrective Action
LCD reads "Helium Temp-ERR"	Excessive discharge temperature at gas compressor.	**This fault is electronically latched. To reset cycle CB1.** Verify proper operating pressures for gas compressor (suction pressure of 12 psi to 25 psi, discharge of 70 psi to 130 psi). Verify water flow and temperature are within specification (see Table C).
	Oil has been pumped from the coolant loop to the compressor's lower sump.	Try to restart the compressor two times. If it does not start, check the oil level in the upper sight glass of the compressor. Oil should be visible after the compressor has been operating for 15 minutes. Contact Polycold Service if the oil is not visible.
System shutdown; LCD reads "Motor Amps-ERR".	Compressor motor high current switch opened.	**This fault is electronically latched. To reset cycle CB1.** If water and power checks indicate utilities are within specifications, interlocks may be faulty. Consult Polycold Service.
LCD reads "Locked Rotor-ERR"		**This fault is electronically latched. To reset, cycle "CB1" and then press the three round buttons simultaneously. If more than two resets are required, contact Polycold Service.**
	Loss of one power phase.	Verify that voltage for each leg meets the Power requirements indicated in Table B.
	Compressor has shutdown on three (3) Motor Amps-ERR.	Do not attempt to restart. Consult Polycold Service.
LCD reads "Micro-ERR"	Microprocessor internal diagnostics as required.	Consult Polycold Service.
Intermittent operation.	Compressor is cycling on and off.	Check input power, coolant flow, and temperature. Compare with Specifications.
Loss of refrigeration capacity	Compressor malfunction.	Check input power, coolant flow and temperature. Compare with Specifications.
Compressor shuts down, LCD display is blank, circuit breaker is closed.	Fu1 or Fu2 fuse is blown.	Contact Polycold Service to have a qualified electrical technician replace the fuse inside the electrical enclosure.
System shuts down, no error message on LCD.	Fu4, Fu5, or Fu6 fuse is blown.	Contact Polycold Service to have a qualified electrical technician replace the fuse inside the electrical enclosure.

6.3.2 ADDITIONAL INFORMATION ON LCD FAULT CONDITIONS

Restarting After a Power Failure

When the power comes on, the microprocessor will determine if the last shutdown was due to a power outage. If the operator turns off the system by the main breaker, it will be detected as a power outage. If the compressor power was interrupted by a power outage, the compressor and the shield cooler will restart automatically after a one (1) second delay.

If the compressor stops for other reasons, compressor troubleshooting is required.

System Status Display

Normal conditions: When all systems are operating normally, with no system errors, the following lines are displayed on the LCD in the order listed below by scrolling the display. Press the DISPLAY button to scroll the LCD. Scrolling past the bottom of the display will start back at the top and repeat. If the DISPLAY button is pressed and not pressed again after 30 seconds, the display will return to the first line (ET).[1]

Elapsed time in hours to one decimal place
"Helium Temp-OK"
"Water Temp-OK"
"Water Flow-OK"
"Motor Temp-OK"
"Phase Seq (sequence)-OK"
"Motor Amps-OK"
"Locked Rotor-OK"
"Micro-OK"

Error conditions: If a system error occurs that causes an alarm or shutdown condition, the monitor point (as listed above) will change from "OK" to "ERR" and that monitor point will be scrolled to the top for display.

When the operator manually scrolls the display, any point that has not failed will continue to display "OK".

If additional points fail before the operator resets the first error(s), the latest point to fail will change from "OK" to "ERR" and will be scrolled to the top for display. In this way, the operator will see the most recent fault displayed on the LCD and, by manually scrolling the display, can see other error conditions that lead up to the latest.

Clearing Error Conditions

The preferred reset method is to cycle "CB1". Alternatively, the faults can be cleared by pressing the "ON" and "DISPLAY" buttons simultaneously.

Restarting after an Error Condition

When the shut-down is caused by any of the high-temperature switches, the compressor will restart only after it has cooled enough for the switch to close. After waiting for the compressor to cool, clear the error message then push the ON button to restart. Should the compressor fail to start, allow more cooling time. Repeat the restart procedure. Check cooling water temperature and flow. Compare with Specifications.

The motor high winding temperature relay automatically resets after the compressor shuts down and the relay cools. This typically takes about 30 minutes. To restart the compressor, clear the error message, and then push the "ON" button. If the compressor fails to start, allow more cooling time. Repeat the restart procedure.

[1] Note: The display refers to helium. For this system, all messages showing helium refer to the nitrogen gas being used.

6.4 AUTOFILL TROUBLESHOOTING BASICS

1. Verify the nitrogen supply pressure is in the correct range, 70 – 90 psi.

2. Verify that the auto-refill switch is ON and the red display illuminates on the SMC pressure switch.

3. Verify that the SMC pressure switch does not blink. If it does, turn off auto-refilll switch for 1-2 minutes then turn it back on. If it is still blinking, remove one lead on the coil of the auto-refill solenoid valve. If it stops blinking, replace the coil.

4. Verify that the SMC pressure switch setting is correct.
   a. Push and hold the set button for more than two seconds; then release it. The display should show “PSI”. Push the set button again. If “PSI” is NOT shown, push the left or right scroll button until “PSI” is displayed; push the set button again.
   b. The display should show “1nC.” If not, push the left or right scroll button until the display shows “1nC.” Then, push the set button.
   c. The display should show “2nC.” If not, push the left or right scroll button until the display shows “2nC.” Then push the set button.
   d. The display should show “768.” If not, push the left or right scroll button until the display shows “768”. Then push the set button.
   e. The display should show “$\bar{n}An$.” If not, push the left or right scroll button until the display shows “$\bar{n}An$”. Then push the set button.
   f. Check each set-point by pushing and holding the set button for less than two seconds. A correct set of set-points should be n_1 > n_2 > n_3 > n_4 > 8. If not, push the left or right scroll button to desired valve, and then push the set button.
   g. See section 7.6 in Polycold’s 825105 *Customer Instruction Manual* for reprogramming instructions.

6.5 AUTOFILL TROUBLESHOOTING MATRIX

Problem	Possible Cause	Corrective Action
Unit does not fill during initial nitrogen fill.	Incorrect N2 fill pressure. There may be loose wiring somewhere.	• Make sure 70-90 psi is supplied at gas fill line. • Open the E-box and check to see if relay #6 is lighted. If it is, check the autofill solenoid valve to feel whether its coil is warm. If the coil is warm, and there is no nitrogen filling, replace the solenoid valve. If the coil is not warm, check its input voltage. If it is 24V, replace the coil. If it is zero, check to see if there is loose wiring somewhere. • If relay #6 is dim, check the green indicator on SMC. If it is ON, check the voltage between the Black and Brown lead of the SMC. If the voltage is zero, the SMC is bad.
Unit continues to fill; LCD reads "OVER RESET VALUE" during initial nitrogen fill.	Bad solenoid valve or SMC.	• Check the status of relay #6. If it is dim, check the autofill solenoid valve; feel its coil to see if it is warm. If the coil is cold, but unit continues filling, replace the solenoid valve. • If relay #6 is lighted, check the green indicator of SMC. If it is OFF but the voltage between the Black and Brown lead is 24VDC, the SMC is bad.
Unit does not refill during a run.	Bad solenoid valve or SMC. Loose wiring in the system.	• Check to see if relay #5 is lighted. If it is, check the autofill solenoid valve to feel whether its coil is warm. If the coil is warm, but no nitrogen filling occurs, replace the solenoid valve. If the coil is not warm, check its input voltage. If it is 24V, replace the coil. If it is zero, check to see if there is loose wiring somewhere. • If relay #5 is dim, check the red indicator on SMC. If it is on, check the voltage between the White and Brown lead. If the voltage is zero, the SMC is bad. If it is 24 V, check to see if there is loose wiring somewhere.
Unit continues to fill; LCD reads "OVER RESET VALUE" during a run.	Loose wire, bad solenoid valve or SMC.	• Check whether relay #4 has been energized. If not, there is a loose wire. If it is energized, continue to next bullet. • Check the status of relay #5. If it is dim, check the autofill solenoid valve to feel whether its coil is warm. If the coil is cold, but nitrogen filling continues, replace the solenoid valve. Otherwise, continue to next bullet. • If relay #5 is lighted, check the red indicator of the SMC. If it is off, but the voltage between the White and Brown lead is 24 VDC, the SMC is bad.
Red LED display is flashing, Autofill function not working.		• Cycle power for Autofill on / off switch. Also cycle "CB2".

See section 9.0 for detailed Autofill schematic

6.6 AUTOFILL STATUS TABLES

1) Initial Fill

SMC Pressure (p)	p < n3	n3 < p < n1	p >= n1
Green Indicator on SMC	On	On	Off
Red indicator on SMC	On	Off	Off
Relay #4	Off	Off	Off
Relay #5	On	Off	Off
Relay #6	On	On	Off
Autofill Solenoid Valve	On	On	Off

2) Idle (unit has been filled but nitrogen compressor is off)

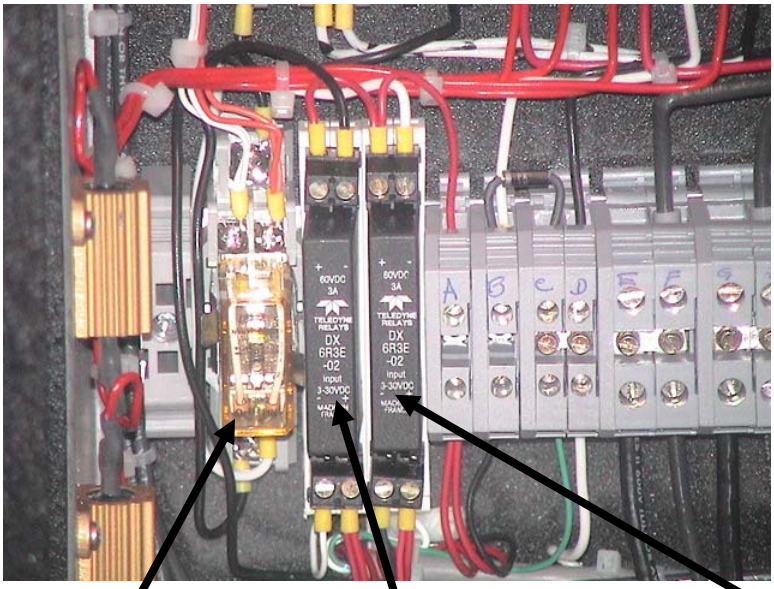
SMC Pressure (p)	p < n2	p >= n1
Green Indicator on SMC	On	Off
Red indicator on SMC	Off	Off
Relay #4	Off	Off
Relay #5	Off	Off
Relay #6	On	Off
Autofill Solenoid Valve	On	Off

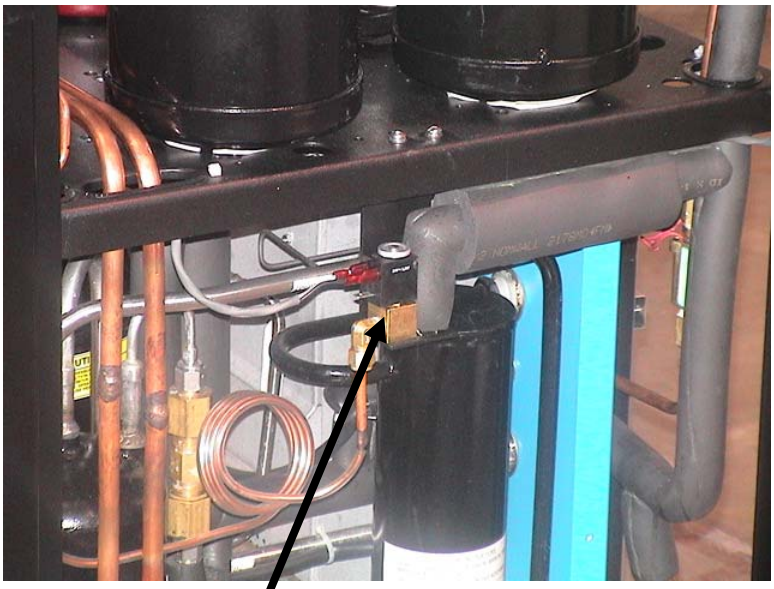
3) Run (unit has been filled and nitrogen compressor is on)

SMC Pressure (p)	p < n4	p >= n3
Green Indicator on SMC	On	On
Red indicator on SMC	On	Off
Relay #4	On	On
Relay #5	On	Off
Relay #6	On	On
Autofill Solenoid Valve	On	Off

6.7 AUTOFILL RELAYS AND SOLENOID VALVE

2XCL Autofill Relays and Solenoid Valve





6.8 ADJUSTING AUTOFILL CONTROL SETTINGS

This section describes how to adjust the settings of the autofill controller (PS4).

⚠ CAUTION!

INCORRECT ADJUSTMENT MAY RESULT IN UNIT FAULTS

Do not adjust these settings unless specifically authorized by the tool manufacturer. Contact the tool manufacturer before making any control setting adjustments.

The controller has been factory set with the following settings:

Unit of measure = psig
Set-point when gas compressor off (n2): 70 psig.
Reset-point when gas compressor off (n1): 75 psig.

Set-point when gas compressor on (n4): 19 psig.
Set-point when gas compressor on (n3): 23 psig.

Even when not powered, the controller will retain these settings for 5 – 10 years. Readjustment is not needed under normal circumstances. Do not adjust these settings unless specifically authorized by the tool manufacturer. Failure to do so may result in tool down-time.

Procedure to verify Pressure Switch Set-up

1. Turn on the auto refill On/Off switch. Red display on SMC should illuminate.
2. Push set button for more than 2 seconds. Display should show “PSI”, push set button. If not, push the left or right scroll button until display “PSI”, then push set button.
3. Display should show “1nC”. If not, push the left or right scroll button until display “1nC”. Push set button.
4. Display should show “2nC”. If not, push the left or right scroll button until display “2nC”. Push set button.
5. Display should show “768”. If not, push the left or right scroll button until display “768”. Push set button.
6. Display should show y “$\bar{n}An$”. If not, push the left or right scroll button until display “$\bar{n}An$”. Push set button.
7. Push set button for less than 2 seconds. Display should show “n_1” and “75”. If it is not “75”, push the left or right scroll button until display “75”. Push set button.
8. Display should show “n_2” and “70”. If not “70”, push the left or right scroll button until display “70”. Push set button.
9. Display should show “n_3” and “23”. If not “23”, push the left or right scroll button until display “23”. Push set button.
10. Display should show “n_4” and “19”. If not “19”, push the left or right scroll button until display “19”. Push set button.

7.0 APPENDIX

7.1 BRAZING SPECIFICATION

Tools and materials needed:

Tubing cutter
Reamer
Sand paper or wire brush or steel wool
Pressure or flow regulated dry nitrogen GAS
Oxy-acetylene torch or air-acetylene torch (propane is not hot enough)

For copper-to-copper joints:

Harris Dynaflow® or Handy & Harman Sil-Fos 6M® or equivalent alloy

For copper-to-stainless steel or copper-to-brass joints:

Harris Safety-Silv 56® or Handy & Harman Braze 560® or equivalent silver alloy
Harris Stay-Silv® black flux or Handy Flux type B-1 or equivalent

Note: Brazing operations must be performed by qualified technicians.

1. Thoroughly clean all mating surfaces to bare metal.
2. Purge the tubes with dry nitrogen GAS while brazing and until the tubes and joints have cooled to below 190° C. (This prevents internal scale formation or oxidation.)
3. Remove all excess flux from the brazed joints. Use a wet rag while the brazed joint is still hot.
4. Dispose of the contaminated waste in a manner approved by the location.
5. Carefully inspect each joint for the proper flow of the brazing alloy (both surfaces should be “wetted” by the alloy).
6. Carefully check all joints for leaks.

7.2 THERMOCOUPLE ATTACHMENT SPECIFICATION

Tools and materials needed:

Type K Thermocouple wire
Thermal wire strippers

Tools and materials needed for soldering:

Sand paper
Propane torch
Rosin flux
Harris Bridgit® or equivalent lead-free solder
Neutralizing agent (to remove the flux)

Note: Brazing operations should be performed by qualified technicians only.

1. Thoroughly clean all mating surfaces to bare metal.
2. Purge the tubes with dry nitrogen gas while brazing and until the tubes and joints have cooled to below 190º C.
3. Remove half an inch (13 mm) of insulation from one end of the thermocouple wire and twist the two wires together.
4. Apply flux and pre-tin the twisted wires.
5. Use sand paper to remove oxidation from the copper tube.
6. Apply flux and pre-tin the tube.
7. Apply flux to the pre-tinned wires and to the pre-tinned copper tube.
8. Position the thermocouple wire so that the first twist of wire (nearest the insulation) is against the tube.

   Note: Make certain the wire twist closest to the insulation is in contact with the copper tube. *(It is the first twist of wire closest to the insulation that senses and determines the temperature reading.)*

9. Solder the wire twist to the copper tube. Do <u>not</u> overheat the flux. Do <u>not</u> melt or cut the plastic insulation on the thermocouple wire- it may create false readings.
10. Remove the flux residue using a wet cloth.
11. Dispose of the contaminated waste in a manner approved by the location.
12. Wrap the thermocouple wire tightly around the tube 3-4 times.
13. Secure the wire with tie wrap(s) or tape suitable for ultra-low temperatures. Allow enough thermocouple wire to reach your temperature meter.
14. Apply insulation per Section 2.5 “Install the External GAS Circuit”.

7.3 SPECIFICATIONS

Dimensions:	See Figure 3 and Figure 4	
Shipping Weight: Based on 200 lb for wooden crate	~ 910 lbs (413 kgs)	
Installed Weight :	~ 710 lbs (322 kgs) (max 230 lbs (104 kgs) / leveling foot)	
Electrical Requirements, 5300 W Required circuit breaker: Acceptable Voltage Range: 60 Hz:	440V 16 A 396V -484V	480V 16 A 432V -528V
GAS-In & GAS-Out Lines:	½" x 6" Linde Bayonet connectors	
Water Temperature:	15° C – 30° C	
Cooling Water Required:	10 gpm @ 25 – 30° C, 6 gpm @ 15 – 25° C	
Cooling Capacity:	490W at -40°C Chuck Outlet Temperature and 20 scfm gas flow	
Noise Emissions (SPL):	74.5 dB(A)	
Ambient Temperature:	10º C to 35º C	
Ambient Humidity:	10 to 85% RH (maximum dew point 27º C)	
Altitude:	0 to 3000 m	
Voltage Fluctuation:	Complies with Semi F-47, survives 1 second loss of power without unit tripping circuit breakers (single occurrence)	
Over voltage category per EN 61010-1:	Category 2	

7.4 DESIGN DATA

Balance Pressure:	175 – 205 psig
GAS Flow Rate Range:	18 – 24 SCFM
Approximate Heat Rejection Rate:	8500 W (29,000 BTUH)
Accessories & Refrigerant Charges:	The refrigerant charge for your unit is specified on the unit nameplate. Contact your local sales representative or Polycold for a current price list.

CONVERSION FACTORS & FORMULAS

1 psig = 0.07 bar = 0.07 kg/cm^2

1 inch = 2.54 centimeters, exactly

1 pound = 0.45 kilograms

1 standard cubic foot per hour (SCFH) = 0.47 standard liters/minute

°F = (9/5 x °C) + 32

°C = 5/9 (°F – 32)

7.5 INSTRUCTIONS FOR INSTALLATION OF SEISMIC ANCHOR/JACK SCREWS

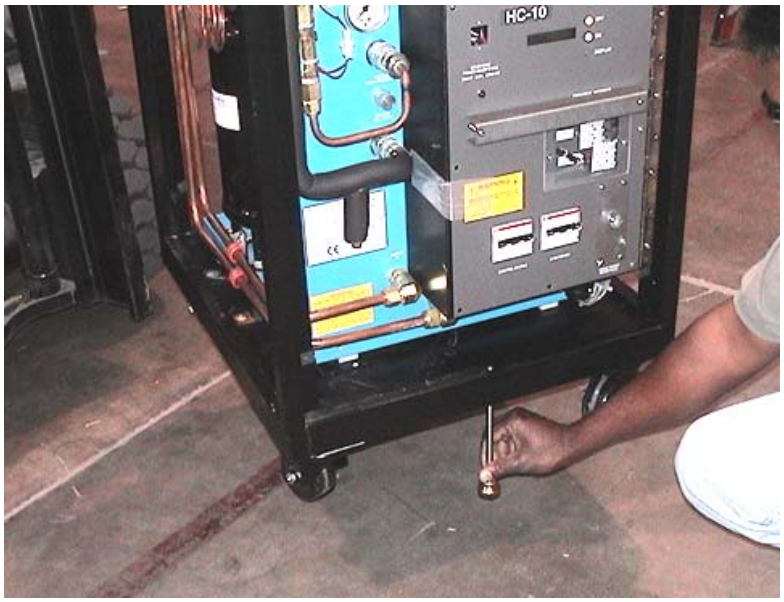
This procedure describes installation of the seismic anchor/jack screws on Polycold's *Cool Solutions*® 2XCL (PGCL-1) and 2XCL (PGCL-2) models. *Note: Option shown has seismic anchor/jack screws 1 ea all 4 sides. Some options have 2 ea front and rear.

1. Remove the four panels (front, two sides, and lower back).

2. Lift the unit up about 18 inches (0.5 meters) off the ground using a forklift, lifting hooks, and a harness.

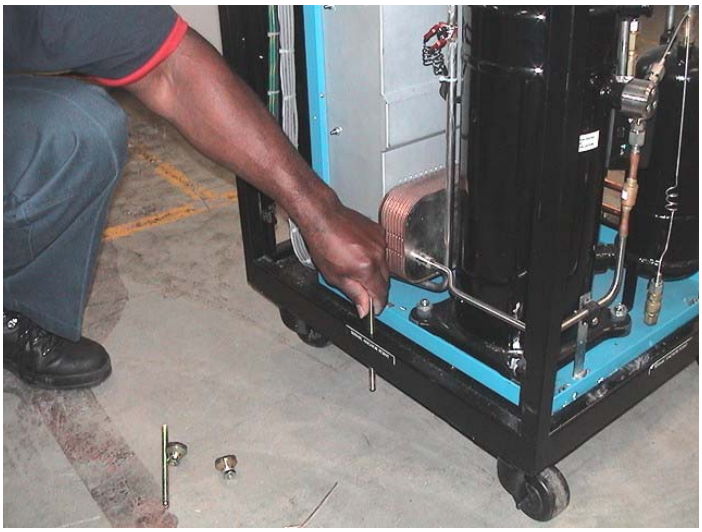
	⚠ WARNING!
	LIFTING HAZARD (900 pounds (400 kg)) **Failure to properly lift this device may result in severe injury or death** If lifting using the lifting eyes (shown below): Assure that the eyes are fully engaged in the frame with no exposed threads. Use all four lifting eyes with an adequate lifting harness and mechanism. Lifting harness must be centered between the lifting eyes. Lift vertically only with no horizontal component. If lifting from the bottom using a forklift, use only appropriate equipment, operated by trained employees. Strap the unit to the vertical back support of the forklift to prevent the unit from tipping over when on the forks.

3. Install threaded rod in front of unit. Locate opening on bottom side of frame centered in the front and labeled “Seismic Anchor Point”. Identify end of threaded rod with machined flats. This is the top. Insert top of threaded rod from below and thread up through frame until flats are exposed. Install pad onto bottom of threaded rod. Use a wrench on the pad and the flats to tighten. Thread leveling foot higher up so that the pad will not contact the floor when the machine is lowered to the ground.



4. The remaining seismic anchor/jack screws can be installed with the unit on the floor, supported by the casters. Place the unit on floor and remove forklift or lifting harness.

5. Screw in other three seismic anchor/jack screws from top and put the pad from bottom. For these seismic anchor/jack screws, thread the rod in from the top, keeping machined flats at top. After threading the rod though the frame and with about two inches of exposed thread below the frame, install pad. Use a wrench on the pad and the flats to tighten.



6. Position the unit where it will be installed. Lower each of the four seismic anchor/jack screws to the floor. Turn each leveling foot by one turn. DO NOT extend jack screw to point where caster will spin. Verify that the unit is secure and will not roll. If not, add one more turn to each leveling foot. Repeat as needed until unit is secure and will not roll.

	⚠WARNING! TIPPING HAZARD, HIGH CENTER OF GRAVITY, LESS THAN 10º MAX TILT ANGLE Maintain weight on casters at all times.

7. Reinstall panels after installing all seismic anchor/jack screws.

8.0 GLOSSARY

ANSI: American National Standards Institute

ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers

AWG: American wire gauge

CE: European conformity

Coldest Liquid: portion of the refrigerant circuit, which obtains the lowest temperature prior to evaporation

Compressor: component in the refrigeration unit that raises the refrigerant pressure and causes the refrigerant to move through the circuit

Compressor Compartment: the portion of the refrigeration unit that contains the compressor and condenser

Condenser: component in the refrigeration unit that removes heat from the refrigerant vapor after it exits the compressor

Cryopump: Polycold's cryogenic refrigeration system that captures water molecules in a vacuum chamber. It consists of a refrigeration unit, a refrigerant line, and a cryosurface (with cryogenic feedthrough).

Cryosurface: the coil or baffle in the vacuum chamber that captures water molecules by freezing them to its surface

Discharge Line: portion of the refrigerant circuit, containing high-temperature, high-pressure refrigerant just after it has exited the compressor

EC: European Community

EEC: European Economic Community

EMC: electromagnetic compatibility

EN: European norm (or standard)

Feed Line: the copper tube in the refrigerant line that carries refrigerant from the refrigeration unit to the cryosurface

Field Replacement Charge: refrigerant mixture that replaces the refrigerant in the cryopump

FNPT: Female national pipe thread

HC-10E1 Compressor -- Located inside the 2XCL, it provides recirculating, inert, high-pressure helium gas to the host equipment.

IEC: International Electrotechnical Commission

I/O: input / output

Liquid Line: portion of the refrigerant circuit containing high-pressure refrigerant just after the water-cooled condenser has cooled it

Manifold: service manifold gauge set

NEC: national electrical code

NPT: national pipe thread

OFHC: oxygen free, high capacity

Polycold stack: the upper portion of the refrigeration unit that is insulated with foam

Recharge: procedure for replacing the refrigerant in a cryopump

Refrigerant: a proprietary mixture of refrigerants made by Polycold Systems International

Refrigerant Circuit: the path of the refrigerant, which goes from the refrigeration unit, through the feed line, through the cryosurface, through the return line, and back to the refrigeration unit

Refrigerant Expansion Tank: tank inside the refrigeration unit that maintains the gaseous refrigerant at a safe pressure when the unit is not at operating temperature

Refrigerant Line: insulated feed and return lines that carry refrigerant to and from the cryosurface

Refrigeration Unit: the machine containing the compressor, condenser and Polycold stack that cools the refrigerant mixture to cryogenic temperatures

Return Line: the copper tube in the refrigerant line that carries refrigerant from the cryosurface to the refrigeration unit

SAE: Society of Automotive Engineers

TC: thermocouple

Top-off Charge: refrigerant mixture that can be added to the refrigerant in the cryopump

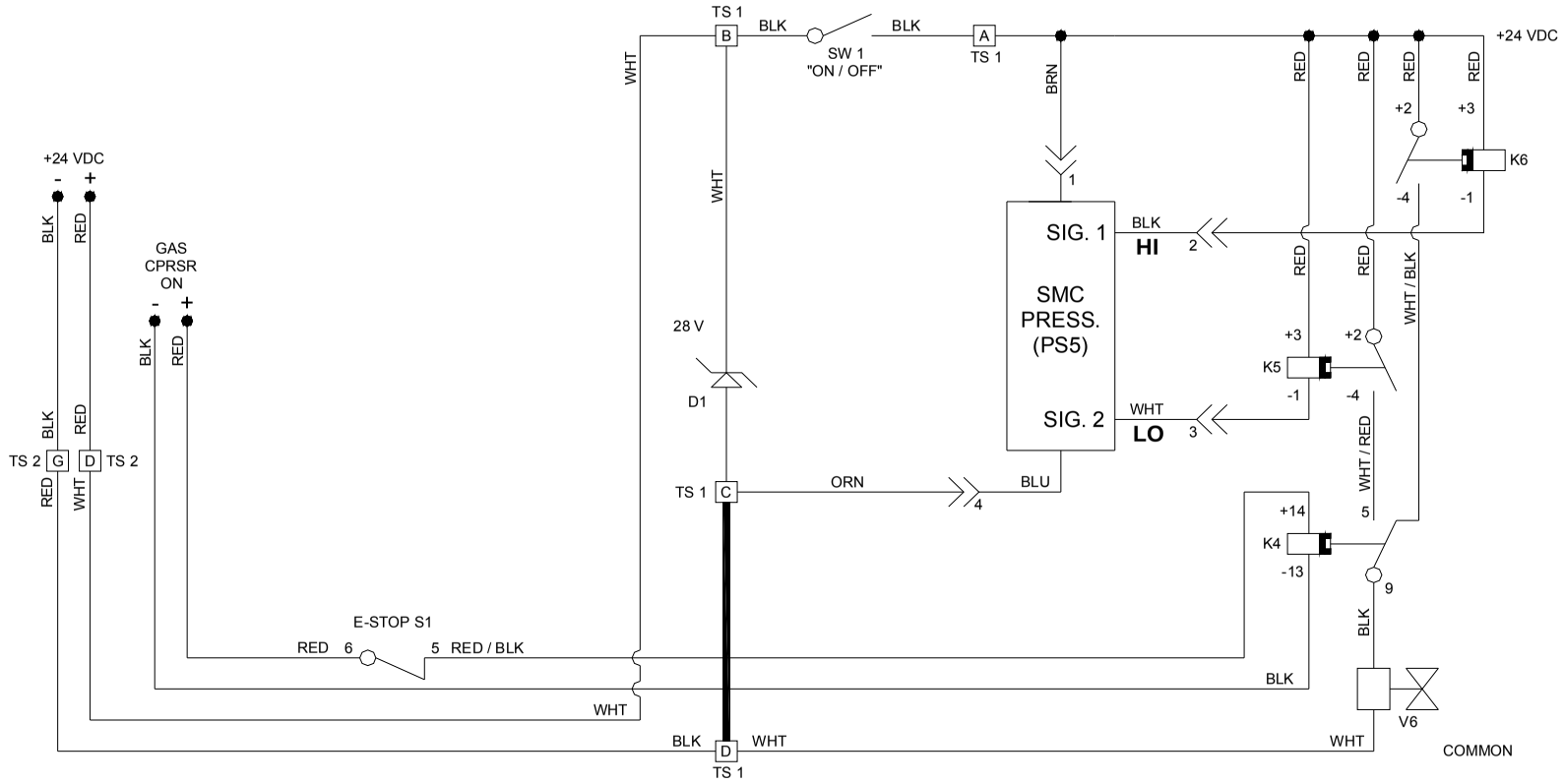
TÜV: Technical Supervision Society—organization that verifies compliance with EN and IEC standards

UL: Underwriters Laboratories— organization that verifies compliance with NEC standards

Vacuum Jacketed Gas Lines -- Connect the compressor to the vacuum process system. The supply gas line carries high-pressure inert gas from the compressor to the host equipment and another gas line returns low-pressure gas from the host equipment back to the compressor.

9.0 PROCESS & INSTRUMENTATION AND ELECTRICAL SCHEMATICS

REVISIONS				
APVD/DATE	REV		DATE	ECO
DMS 3/5/03	00	NEW	12/13/02	
NN 6/7/05	01	NEW	JPR 6/7/05	5043



LEGEND	
X	TERMINAL STRIP
	CONNECTOR
	TERMINAL BUS

SEE SEPARATE PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± 1/16 DECIMALS .X = ±N/A .XX = ±N/A .XXX = ±N/A ANGLES ±½°

MATERIAL/FINISH: SEE PARTS LIST

DRAWN/DATE: NN 2/10/03

DO NOT SCALE DRAWING

THE INFORMATION CONTAINED IN THIS DOCUMENT IS HELIX POLYCOLD SYSTEMS INC. PROPRIETARY INFORMATION AND IS DISCLOSED IN CONFIDENCE. IT IS THE PROPERTY OF HELIX POLYCOLD SYSTEMS INC. AND SHALL NOT BE USED, DISCLOSED TO OTHERS OR REPRODUCED WITHOUT THE EXPRESS WRITTEN CONSENT OF HELIX POLYCOLD SYSTEMS INC. IF CONSENT IS GIVEN FOR REPRODUCTION IN WHOLE OR IN PART, THIS NOTICE AND THE NOTICE SET FORTH ON EACH PAGE OF THIS DOCUMENT SHALL APPEAR IN ANY SUCH REPRODUCTION IN WHOLE OR IN PART. INFORMATION CONTAINED IN THIS DOCUMENT MAY ALSO BE CONTROLLED BY THE U.S. EXPORT CONTROL LAWS. UNAUTHORIZED EXPORT OR RE-EXPORT IS PROHIBITED.

THIRD ANGLE PROJECTION

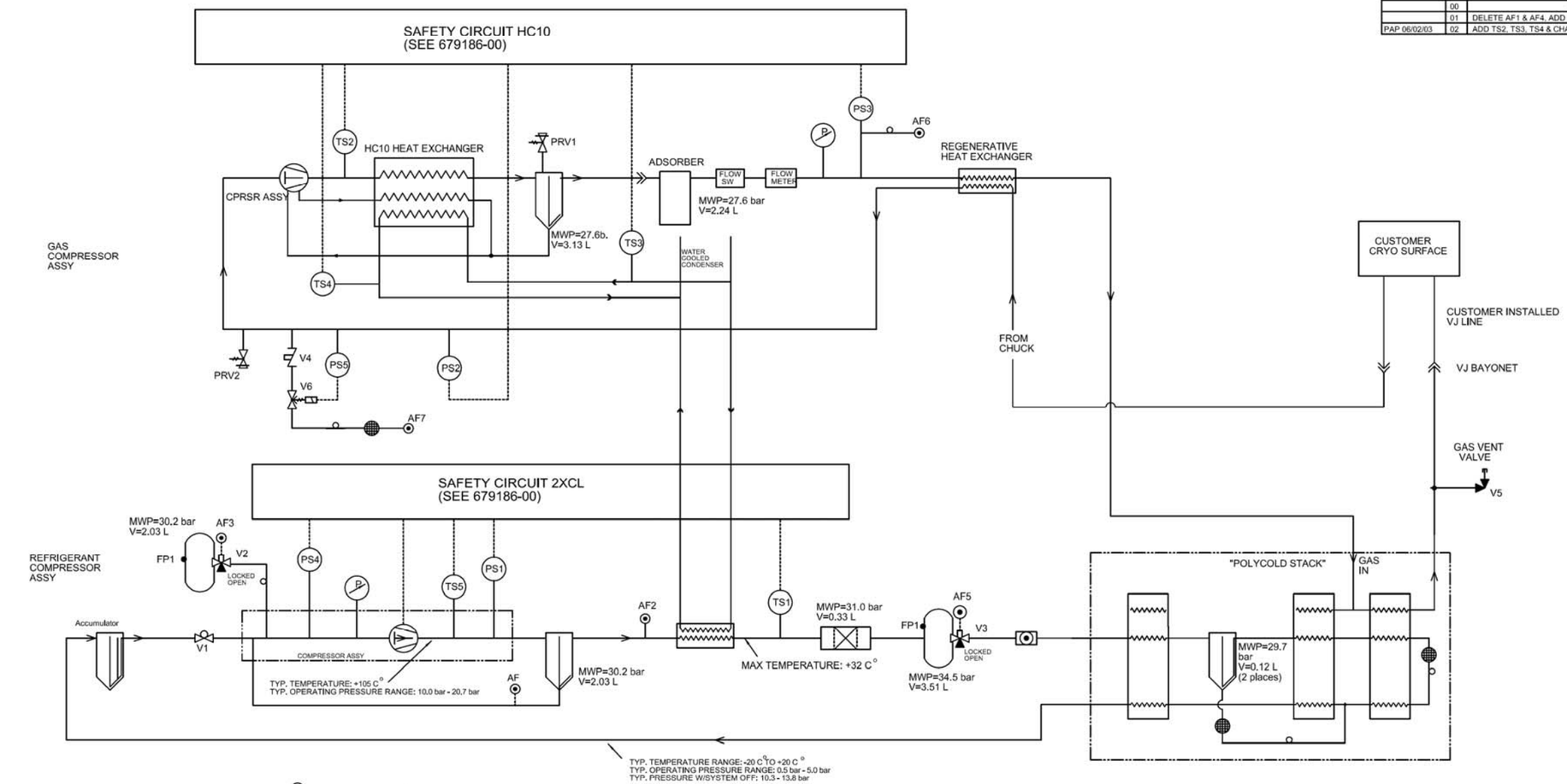
POLYCOLD SYSTEMS
HELIX TECHNOLOGY CORPORATION
3800 Lakeville Highway, Petaluma, CA 94954 (707) 769-7000

CKT DIAG PGCL2-V3
GAS AUTO FILL CONTROL

SIZE C | DWG NO. 679188-00 | REV 01

SCALE: NONE | SHEET 1 OF 1

REVISIONS				
AP/D/DATE	REV	DESCRIPTION	DWN/DATE	ECO
	00	NEW	FZ 9/16/02	
	01	DELETE AF1 & AF4, ADD TEXT CPRSR ASSY`S	DMS 4-30-03	
PAP 06/02/03	02	ADD TS2, TS3, TS4 & CHANGE NAMES	DJT 07/02/03	



Phase Separator
Oil Separator
Strainer
Filter-Drier
Heat Exchanger
Service Access Fitting
Capillary Tube
Control and Instrumentation
Pressure Gauge
Service Valve, 3 way
Ball Valve
Check Valve
Manual Valve
Solenoid Valve
Pressure Relief Valve
Moisture Indicating Sight Glass
Accumulator

	NAME	SETPOINT	
PS1	REFRIGERANT HIGH PRSSURE SWITCH	P > 27.9	bar
PS2	COOLANT LOW PRESSURE SWITCH	P < 0.14	bar
PS3	COOLANT HIGH PRESSURE SWITCH	P > 10.6	bar
PS4	REFRIGERANT LOW PRESSURE SWITCH	P > 0.14	bar
PS5	AUTOREFILL PRESS SENSOR	G. Comp. on:19(on)-23(off) G. Comp.Off:70(on)-75(off)	psi
PRV1	PRESSURE RELEF VALVE	P > 27.6	bar
PRV2	PRESSURE RELEF VALVE	P > 10.3	bar
FP1	FUSIBLE PLUG	T > 183	°C
HTS/OR TS1	REFGT, LIQUID LINE TEMPERATURE SWITCH	T > 40	°C
TS2	GAS COMPRESSOR DISCH TEMP SWITCH	T > 40	°C
TS3	GAS COMPRESSOR WATER IN TEMP SWITCH	T > 40	°C
TS4	GAS COMPRESSOR WATER OUT TEMP SWITCH	T > 40	°C
TS5	REFRIGERANT CPRSR DISCHARGE TEMP	T > 129.4	°C

VALVES	
V1	COMPRESSOR SUCTION SERVICE VALVE
V2	EXPANSION TANK SERVICE VALVE
V3	EXPANSION TANK SERVICE VALVE
V4	CHECK VALVE - GAS FILL
V5	SERVICE VALVE - GAS VENT
V6	REFILL SOLENOID VALVE

ACCESS FITTINGS (AF)	
AF1	COMPRESSOR SUCTION AF
AF2	COMPRESSOR DISCHARGE AF
AF3	BUFFER TANK AF
AF4	OIL RETURN AF
AF6	GAS VENT AF
AF7	REFILL AF

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TORLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± XX = ±
XXX =
MATERIALS/FINISH
DRAWN/DATE
FZ 09/13/2002
DO NOT SCALE DRAWING

THE INFORMATION CONTAINED IN THIS DOCUMENT IS HELIX POLYCOLD SYSTEMS INC. PROPRIETARY INFORMATION AND IS SUBMITTED IN CONFIDENCE FOR THE SOLE PURPOSE OF USE BY HELIX POLYCOLD SYSTEMS INC. AND SHALL NOT BE USED DISCLOSED TO OTHERS OR REPRODUCED WITHOUT THE EXPRESS WRITTEN CONSENT OF HELIX POLYCOLD SYSTEMS INC., IF CONSENT IS GIVEN FOR REPRODUCTION IN WHOLE OR IN PART, THIS NOTICE AND THE NOTICE SET FORTH ON EACH PAGE OF THIS DOCUMENT SHALL APPEAR IN ANY SUCH REPRODUCTION IN WHOLE OR IN PART. INFORMATION CONTAINED IN THIS DOCUMENT MAY ALSO BE CONTROLLED BY THE U.S. EXPORT CONTROL LAWS. UNAUTHORIZED EXPORT OR RE-EXPORT IS PROHIBITED.

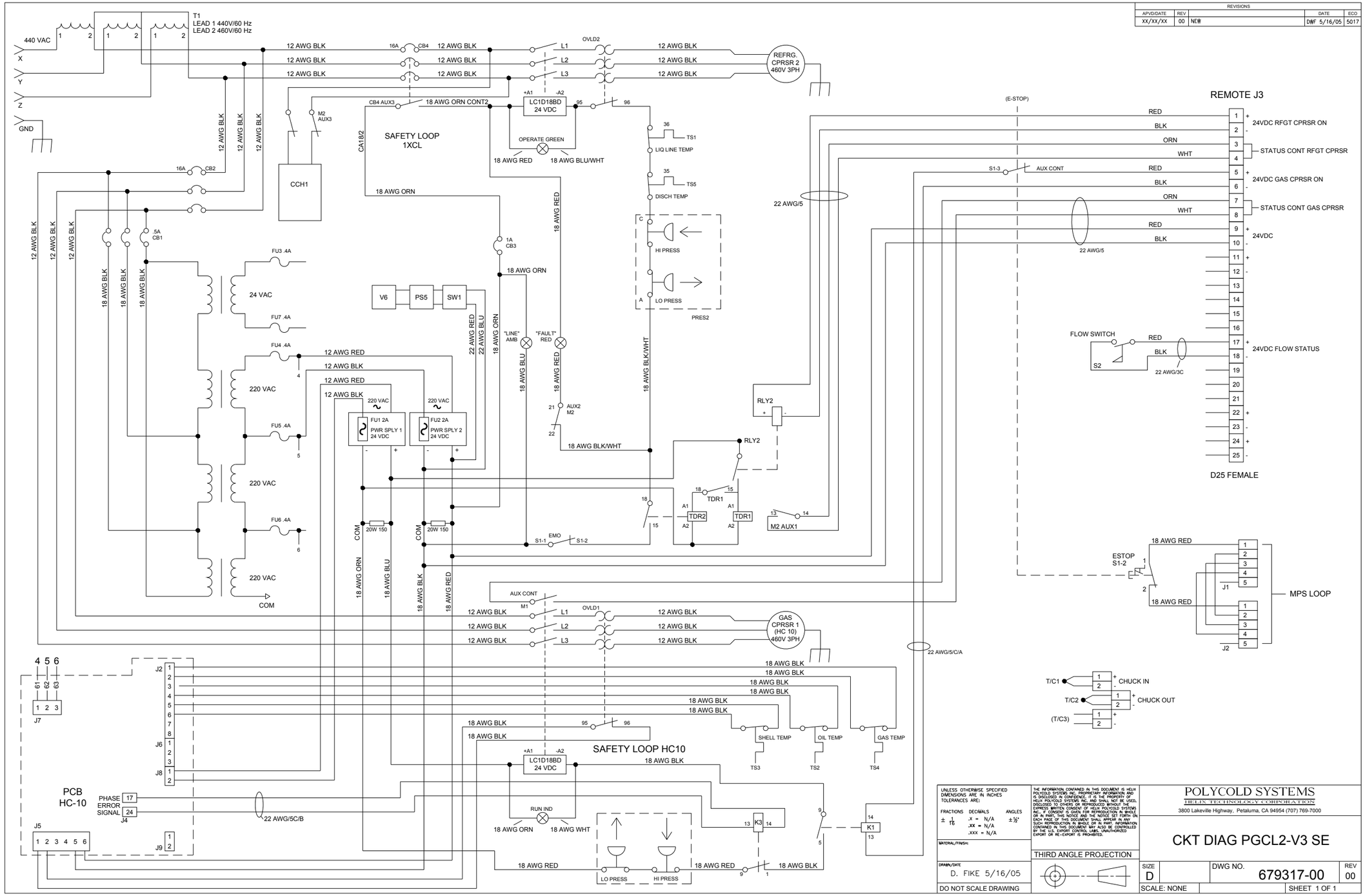
THIRD ANGLE PROJECTION

POLYCOLD SYSTEMS
HELIX TECHNOLOGY CORPORATION
3800 Lakeville Highway, Petaluma, CA 94954 (707) 469-7000

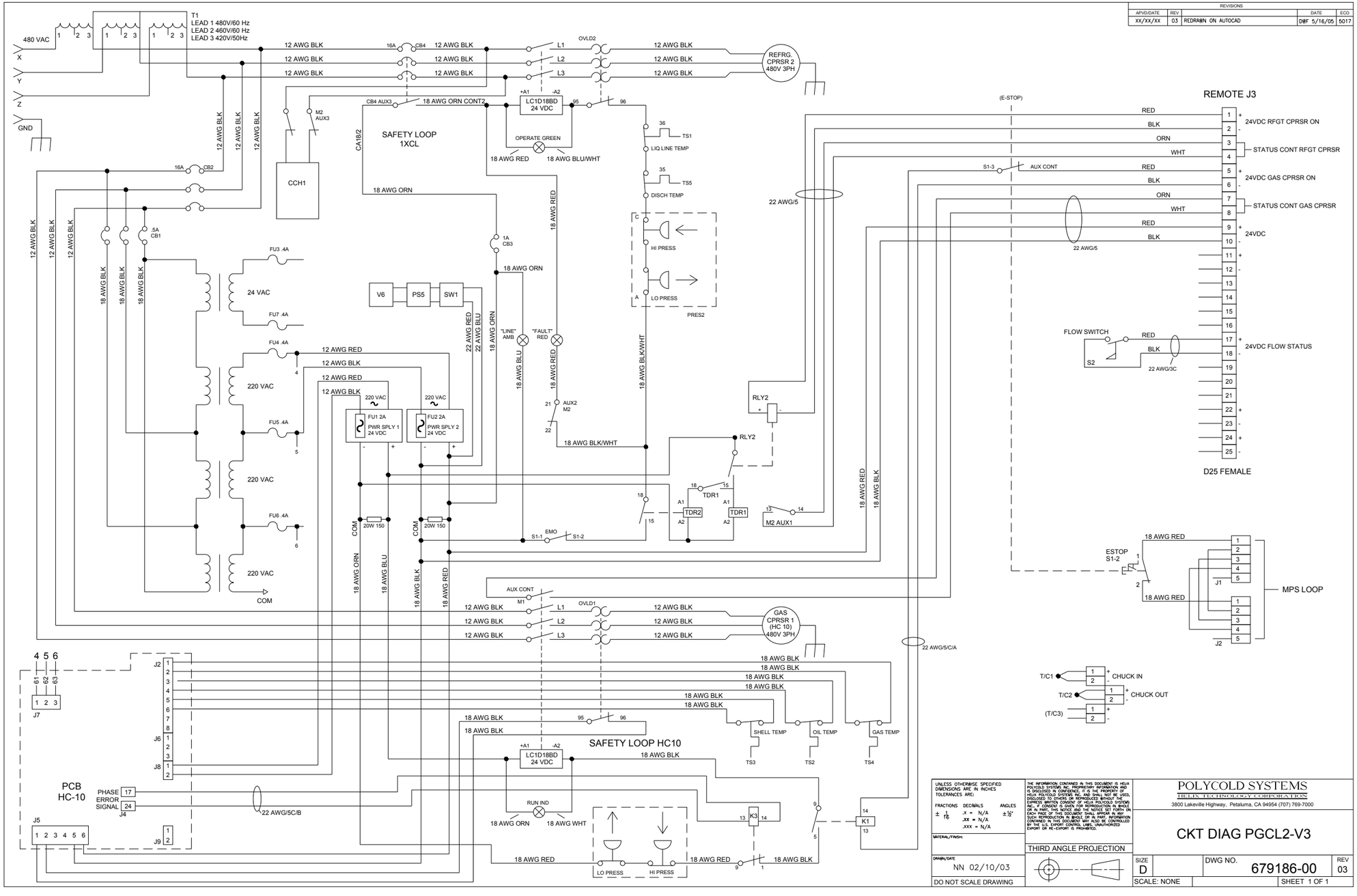
PGCL2-V3 P&ID

SIZE B | DWG NO. 690043-00 | REV 02
SCALE | SHEET 1 OF 1

Process & Instrumentation Diagram



Electrical Schematics (440V)



Electrical Schematics (480V)